Comparison of the effects of 70% alcohol, 10% povidone-iodine and 0.4% chlorhexidine which are used in umbilical care on colonization and umbilical cord separation time

Hüsniye Aydemir¹, Özgür Alparslan²* and Yeltekin Demirel³

¹Yeşilyurt Health House, Tokat, Turkey.
²School of Health Sciences, Gaziosmanpaşa University, Tokat, Turkey.
³Department of Family Medicine, Faculty of Medicine, Çumhuriyet University, Sivas, Turkey.

Accepted 15 March, 2012

This research has been designed and conducted as a randomized controlled trial to evaluate the effect of three regimens of cord care on cord separation time and umbilical cord colonization. Umbilical cord cares of 70% alcohol, 10% povidone-iodine and 0.4% chlorhexidine were applied to 40 term neonates who were randomly assigned (N = 120). Wipe samples were taken from babies just after the delivery and re-taken from umbilicus on the 5th day, and the separation time of umbilical cord was determined. The mean time to cord separation was significantly higher in the 70% alcohol group (7.10 ± 1.61, p < 0.05). There were significant differences between the groups considering the culture results on the 5th day (p < 0.05); coagulase-negative staphylococci reproduced in a substantial part (27.5%) of the babies applied with 70% alcohol cares. Alcohol use delayed the time for cord separation compared to other methods. The authors concluded that 0.4% chlorhexidine may be effectively and safely used for umbilical cord care of healthy term neonates.

Key words: Newborn, bacterial colonization, alcohol, povidone-iodine, chlorhexidine, umbilical cord separation.

INTRODUCTION

Umbilicus is the most convenient place for bacterial colonization causing infections like omphalitis and sepsis in newborn babies. Infection of umbilical cord of newborn babies with Staphylococcus aureus and Escherichia coli could result in serious complications. Performing delivery in sterile conditions, umbilical cord care and avoiding harmful applications could reduce the infection risk in newborn babies. At present, it is aimed to reduce cord infections by using asepsis in umbilical cord care. Umbilical cord care in prenatal and postnatal involves cleaning hands with water and soap before and after care, covering cord with clean clothes after cleaning with antiseptics (once or twice a day) or keeping it dry by leaving open and exposing to air (Perapoch et al., 1993; Medves and O’Brien, 1997; Dore et al., 1998; World Health Organization (WHO), 1999; Ireland et al., 2000; Golombek et al., 2002; Janssen et al., 2003; Patricia, 2003; Mullany et al., 2006, 2009; Suliman et al., 2010). Moreover, American Academy of Pediatrics (AAP) has emphasized the importance of observance of umbilical cord for infections, deep purification of hands before baby care, wrapping diaper below umbilicus, and avoiding bath before the separation of umbilical cord in addition to umbilical cord care (Mcconnell et al., 2004). Researches performed in developing countries demonstrated that application of antiseptic solutions in umbilical cord care reduced the number of harmful bacteria in baby rooms of hospitals and the bacterial colonization in umbilical area (Paes and Jones, 1987; Stark and Harrisson, 1992;
Watkinson and Dyas, 1992; Perapoch et al., 1993; Rush, 1998; Smales, 1998; Aktuglu, 2001; Patricia, 2003; Pezzati et al., 2003; Mcconnell et al., 2004; Oishi et al., 2004; Tabak et al., 2001; Weathers et al., 2004; Zupan et al., 2004; Nourian, 2009).

However, there are controversial ideas on umbilical cord care at present. 70% alcohol is widely used for umbilical cord care (Mcconnell et al., 2004). Although, it is not sufficient to reduce colonization as it evaporates before being absorbed by normal skin. For this reason, alcohol is not suggested for umbilical cord care because of its limited effect on the reduction of colonization, prolonged separation time of umbilical cord and its harmful effects (hemorrhagic skin necrosis, central nervous system dysfunction, metabolic acidosis, and hypoglycemia) (Mcconnell et al., 2004). Another topical antiseptic used for umbilical cord care is 10% povidone-iodine. It has a wide effect spectrum and bactericidal effects on Gram-positive and Gram-negative microorganisms. When absorbed in large quantities, this agent increases the serum iodine level by stimulating neonatal hypothyroidism. For this reason, application with ionic compounds should be kept short and used with great attention (Bakir and Sosyal, 2003).

Chlorhexidine of 0.4% is a wide-spectrum antimicrobial used against Gram-positive and Gram-negative bacteria. Its antibacterial effect is slower than alcohol; however, its permanent effect is stronger due to its affinity to surfaces. It provides an outlasting effect of 6 h by adhering to the stratum corneum layer of skin. Besides, it rarely causes allergic reactions (Bakir and Sosyal, 2003; Mullany et al., 2006, 2009). The opinion that evidence-based medicine can be used in the preventive health services has started to take place on the agenda recently. Ireland et al. (2000) emphasized that applications of umbilical cord care should be based on scientific studies; however, research and records on this matter were inadequate.

On the other hand, there is no standard protocol for umbilical cord care in Turkey, and different methods including 70% alcohol and povidone-iodine are used depending on the personal knowledge or no care is given at all. As a result of this anecdotal approach, toxic effect and various complications could be observed in newborn babies. For this reason, new studies should be carried out to provide scientifically based suggestions.

The main purpose of the present study was to compare the effect of three different cord care regimens: 70% alcohol, 10% povidone-iodine and 0.4% chlorhexidine cord care on the separation time, bacterial umbilical colonization and infection of the umbilical cord stump.

MATERIALS AND METHODS

The study was invited to participate in a prospective, randomized clinical trial related to neonatal umbilical cord care. From April 16, 2006, to December 03, 2006, parents of healthy, full-term newborns admitted to the newborn nursery at the Research and Application Hospital of Sivas Cumhuriyet University, Turkey. The eligible criteria included gestational age ≥ 37 weeks. Infants who had a high risk of infection such as low birth weight (< 2500 g), ≤ 37 weeks, 5th min Apgar score < 7, a maternal history of prolonged rupture of membrane, chorioamnionitis or meconium-stained amniotic fluid, multiple or risky pregnancy (preeclampsia, eclampsia, ablatio placentae, and diabetes mellitus) and sick infants were excluded. The study was explained to the mothers, and informed consent was obtained. All study subjects “roomed in” with their mothers.

Data was collected by using “Informed Consent Form”, “Questionnaire Form Including Introductory Information and Culture Results of Umbilical Area”. Briefly, a computer-generated randomization sequence assigned all infants within cluster to one of three cord care regimens. Umbilical cord cares of 70% alcohol, 10% povidone-iodine or 0.4% chlorhexidine were applied to three randomized groups each consisting of 40 babies randomly (alcohol for the 1st baby, povidone-iodine for the 2nd baby, chlorhexidine for the 3rd baby, and so on). During staying in a hospital nursery, umbilical stump was applied twice with three antiseptic agents for cord care until the time of discharge. In the present study, povidone-iodine was applied to umbilical cord and it was wrapped with gauze bandage damped with serum physiologic after it became dry in 5 min. Therefore, excessive absorbance of povidone-iodine by skin was prevented (WHO, 1999). Wipe samples were taken from the umbilicus of babies just after the delivery and then first umbilical cord care was applied. A second umbilical care was given to babies completing the first 24 h, and mothers were informed on the criteria of umbilical cord care. Wipe samples were re-taken from the umbilicus of babies on the 5th day after delivery and the separation time of umbilical cord was determined. The cord separation time was defined and noted as the age of the infant. The abdominal skin in umbilicus region was observed and omphalitis was determined by the presence of redness, swelling, exudates, tenderness, warmth, and foul smell. Umbilical cord care was standardized with a protocol and performed by a member of the research team during hospital stay. If umbilical cord had not fallen down until the fifth day, the parents were called post-discharge once a week until reported cord separation. All mothers were provided maternal education before discharge including umbilical cord-related observations (any redness, swelling, exudates, tenderness or warmth around umbilicus, foul smell or drainage from cord), hygienic umbilical cord care (such as folding diaper away from cord area, keeping cord and area around it clean and dry, washing hands with clean water and soap before and after baby care and not to apply unclean substances) during the postnatal period.

Wipe samples were cultured aerobically on the media of blood agar, eosin-methylene blue (EMB) and Sabouraud Dextrose, and then incubated for 24 h in stove (at 37°C). Gram staining was performed in the existence of colony. Catalase/coagulase test (for staphylococci) was applied in the presence of Gram (+) cocci. In the presence of growth on Sabouraud Dextrose agar, lactophenol cotton blue method was used to investigate and characterize fungi. The collected culture results, bacterial and fungal colonization on umbilical cord, and the relation between the applied care and the separation time of umbilical cord were assessed.

Statistical analysis

Necessary permissions were obtained from Local Ethical Committee and the units where the study was performed. Obtained data was loaded to SPSS 10.0. Chi-square test, variance analysis (ANOVA) and Tukey test were used for the evaluation of data. Descriptive statistics (mean ± standard deviation, the number and percentage) were used to report sample characteristics, cord detachment time, and the frequency of colonizing organisms. A level of p < 0.05 was considered statistically significant.
Table 1. Distributions of demographic characteristics of mothers and neonates in three groups [70% alcohol (n = 40), 10% Povidone-Iodine (n = 40) and 0.4% Chlorhexidine (n = 40)] of umbilical cord care.

<table>
<thead>
<tr>
<th>Maternal and neonate characteristics**</th>
<th>Umbilical cord care</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>70% alcohol</td>
<td>0.4% chlorhexidine</td>
<td>10% povidone-iodine</td>
</tr>
<tr>
<td></td>
<td>$\bar{x} \pm SD$</td>
<td>$\bar{x} \pm SD$</td>
<td>$\bar{x} \pm SD$</td>
</tr>
<tr>
<td>Maternal age (year)</td>
<td>25.50 ± 5.42</td>
<td>25.97 ± 5.16</td>
<td>27.30 ± 5.47</td>
</tr>
<tr>
<td>Number of pregnancy</td>
<td>1.62 ± 0.83</td>
<td>1.62 ± 0.77</td>
<td>1.80 ± 0.82</td>
</tr>
<tr>
<td>Gestational age (weeks)</td>
<td>38.45 ± 1.15</td>
<td>38.45 ± 1.10</td>
<td>38.67 ± 1.09</td>
</tr>
<tr>
<td>Birth weight (g)</td>
<td>3317.75 ± 297.61</td>
<td>3235.75 ± 321.90</td>
<td>3405.25 ± 282.82</td>
</tr>
<tr>
<td>Apgar score at the first minute</td>
<td>8.80 ± 0.40</td>
<td>8.77 ± 0.42</td>
<td>8.90 ± 0.30</td>
</tr>
<tr>
<td>Apgar score at the fifth minute</td>
<td>9.97 ± 0.15</td>
<td>9.97 ± 0.15</td>
<td>9.87 ± 0.33</td>
</tr>
</tbody>
</table>

*ANOVA: The mean difference is significant at the 0.05 level. **Data presented as mean ± standard deviation.

Table 2. Results of reproduction in the culture samples taken from babies just after the delivery (n = 120)*.

<table>
<thead>
<tr>
<th>Umbilical care</th>
<th>No reproduction</th>
<th>Coagulase-negative</th>
<th>E. Coli</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>Staphylococci</td>
<td>(%)</td>
</tr>
<tr>
<td>70% alcohol (n = 40)</td>
<td>36 (90.0)</td>
<td>4 (10.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>10% povidone-iodine (n = 40)</td>
<td>39 (97.5)</td>
<td>0 (0.0)</td>
<td>1 (2.5)</td>
</tr>
<tr>
<td>0.4% chlorhexidine (n = 40)</td>
<td>39 (97.5)</td>
<td>1 (2.5)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Total</td>
<td>114 (95.0)</td>
<td>5 (4.2)</td>
<td>1 (0.8)</td>
</tr>
</tbody>
</table>

*Table is expressed with percentage values since the reproduction results in the first day after the delivery did not match the assumptions of chi-square test.

RESULTS

In total, 120 consecutive newborn babies with eligibility criteria were included in the study. The distributions of descriptive characteristics of mothers and babies are given in Table 1. Statistically significant differences were not found between three groups regarding birth weights (F = 3.168, p = 0.05), sex of babies (F = 1.638, p = 0.19), Apgar score at the first minute (F = 1.206, p = 0.30), Apgar score at the fifth minute (F = 2.466, p = 0.08), mother’s age (F = 1.213, p = 0.30), number of pregnancy (F = 0.619, p = 0.54), the week of pregnancy (F = 0.539, p = 0.58), and delivery method (F = 2.024, p = 0.13).

In the examination of culture samples just after the delivery, no microbial growth was detected in 95% of babies, proliferation of coagulase-negative staphylococci was detected in 4.2%, and E. coli was found in 1 baby (Table 2).

In the comparison of culture results on the fifth day with umbilical cord care, a significant difference was determined between the study groups (p < 0.05). Coagulase-negative staphylococci reproduced in 27.5% of babies applied with 70% alcohol cares. There was no reproduction in 95% of babies applied with the 10% povidone-iodine, while it was detected in two babies (5%). Similarly, no reproduction was determined in 95% of babies applied with 0.4% chlorhexidine cares, while it was detected in two babies (5%) (Table 3). In addition, no fungal colonization was determined in the same samples.

In the comparison of separation times of umbilical cord according to applied umbilical care method, a significant difference was determined between groups (p < 0.05). The mean separation time of umbilical cord was 7.10 ± 1.61 days in babies applied with 70% alcohol, 6.77 ± 1.54
### Table 3. Relations between the culture results on the fifth day with the applied umbilical cares*.

<table>
<thead>
<tr>
<th>Umbilical care</th>
<th>No proliferation</th>
<th>Coagulase-negative staphylococci</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>70% alcohol (n = 40)</td>
<td>29 (72.5)</td>
<td>11 (27.5)</td>
</tr>
<tr>
<td>10% povidone-iodine (n = 40)</td>
<td>38 (95.0)</td>
<td>2 (5.0)</td>
</tr>
<tr>
<td>0.4% chlorhexidine (n = 40)</td>
<td>38 (95.0)</td>
<td>2 (5.0)</td>
</tr>
</tbody>
</table>

*Assessed by Chi-square tests: χ² = 12.343, p = 0.002

### Table 4. Relation between the separation time of umbilical cord and the applied umbilical cord care.

<table>
<thead>
<tr>
<th>Umbilical care</th>
<th>Separation time of umbilical cord</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X ± SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>70% alcohol (n = 40)*</td>
<td>7.10 ± 1.61</td>
<td>F = 3.69</td>
<td>P = 0.028</td>
</tr>
<tr>
<td>10% povidone-iodine (n = 40)</td>
<td>6.77 ± 1.54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.4% chlorhexidine (n = 40)</td>
<td>6.22 ± 1.16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Tukey test: The mean difference is significant at the 0.05 level

---

days in babies applied with 10% povidone-iodine and 6.22 ± 1.16 days in babies applied with 0.4% chlorhexidine (Table 4).

### DISCUSSION

Study was carried out in three groups, and no significant difference was found between groups considering delivery method, sex, week of pregnancy and Apgar score (p > 0.05). Babies included in the study had the characteristics of normal newborn babies: that is, factors such as prematurity and presence of meconium, which could negatively affect the study results, were eliminated. Cases included in the study are compatible with literature in this regard (Patricia, 2003; Pezzati et al., 2003; Oishi et al., 2004).

Some studies suggest that umbilical cord care with antiseptic fluids reduce the separation time of umbilical cord and increase the cost of care; in addition, no application is superior to the care which leaves umbilicus to natural dryness (Hsu et al., 1999; Chamnanvanakij et al., 2005). WHO (1999) argues that the use of antiseptics is necessary in the first three days following the cut of umbilical cord; however, longtime use of antiseptics prolongs the separation time of umbilical cord and increases the cost of newborn care after the delivery. Midwives and nurses in developing countries express the importance of antiseptics in reducing umbilical colonization. Duruaip (1998) carried out a study using povidone-iodine and alcohol for the umbilical cord care in which mostly the coagulase-negative staphylococci proliferated. In the present study, proliferation of coagulase-negative staphylococci in the group applied with alcohol care was found higher than other umbilical cord care applications. These study findings are compatible with the results obtained by Duruaip (1998).

Chamnanvanakij et al. (2005) compared the applications of triplet colours, alcohol and natural drying, and bacterial colonization rate was found to be higher in the group applied with alcohol. In this regard, the findings of the present study are compatible with the results demonstrated by Chamnanvanakij et al. (2005). In different studies, alcohol was reported to be weaker in reducing colonization compared to other solutions. Alcohol rapidly kills the majority of bacteria in two minutes and prevents umbilical cord from staying wet. However, it instantly evaporates and delays the separation of umbilical cord. In the literature, alcohol was reported less effective to control umbilical colonization and skin infections compared to triplet colours, povidone-iodine and chlorhexidine. The results obtained in the present study show similarities to many studies on umbilical cord care (Rush, 1998; Hsu et al, 1999; WHO, 1999).

Medves and O’Brien (1997) carried out a study to evaluate the differences between alcohol and water regarding the separation of umbilical cord and bacterial colonization times, and no statistically significant difference was detected. The results of present study were incompatible with the study of Medves and O’Brien (1997). No study was encountered about the effectiveness of alcohol in reducing bacterial colonization and infection. In the present study, bacterial reproduction rate was found high in umbilicus of babies applied with alcohol. Consequently, alcohol was concluded to be less powerful to prevent umbilical colonization because of its rapid evaporation. Omphalitis could result in death by causing rapidly
systemic infection and sepsis (Güvenç et al., 1997). Cost, time and workforce losses could emerge on account of the hospitalization of babies diagnosed with omphalitis (Mullany et al., 2006, 2009). To avoid such losses, omphalitis formation can be prevented by applying suitable antiseptics. Kul et al. (2005) carried out a study to investigate the effects of four different umbilical cord care applications (sterile gauze bandage, alcohol with sterile gauze bandage, eosin and povidone-iodine) on the separation time of umbilical cord in newborn healthy babies and other outcomes (omphalitis, sepsis, death, bleeding in umbilical cord). In this comparison, no statistically significant difference was determined between the methods, and one case of omphalitis was detected in the group applied with sterile gauze bandage. No omphalitis case was detected in the babies included in this study.

According to the results reported by Kul (2005), it was found highly important that newborn babies should be definitely applied with antiseptic care after the delivery. Babies should be applied with antiseptic cares in the first few days following the delivery and the separation time of cord is prolonged with overuse of solutions (WHO, 1999). In the present study, umbilical cord of babies applied with alcohol care separated 1 day later compared to other solutions. Pezzati et al. (2003) compared eight different umbilical cord care applications (70% alcohol, natural drying, salicylic sugar powder, triple dye, micronized green clay powder, colloid silver-benzyl-peroxide powder, neomycin-bacitracin powder, 1% basic fuchsine) and investigated bacterial colonization in umbilicus and separation time of umbilical cord. Colonization rate was found lower in three out of eight applications (70% alcohol, natural drying, salicylic sugar, cicatrin); however, separation time of umbilical cord was determined evidently higher in babies applied with 70% alcohol. In contrast to the study performed by Pezzati et al. (2003), separation time of umbilical cord was found longer in the group applied with 70% alcohol in the present study. Dore et al. (1998) compared alcohol and natural dryness considering the separation time of umbilical cord and omphalitis; the mean separation time of umbilical cord was determined as 8.16 days in the group left for natural drying, 9.8 days in the group applied with alcohol care and the difference was found statistically significant. In the present study, the separation time of umbilical cord was found higher in the babies applied with alcohol than other applications and the difference was statistically significant, which were parallel to the study of Dore et al. (1998).

Povidone-iodine is effective against Gram-positive and Gram-negative bacteria, fungi, and viruses but not against spores. Thyroid function tests of newborn babies should be performed as it impairs thyroid functions (WHO, 1999). Use of povidone-iodine for topical disinfection and surgical wound disinfection in infants has been shown to induce hypothyroidism and hyperthyroidism (Brown et al., 1997).

In the present study, povidone-iodine was applied to umbilical cord and it was wrapped with gaseous bandage damped with serum physiologic after it became dry in 5 min. Therefore, excessive absorbance of povidone-iodine by skin was prevented (WHO, 1999). No significant microbial growth was detected in umbilicus of babies applied with povidone-iodine; however, separation time of umbilical cord was determined as 6.77 ± 1.54 days.

Chlorhexidine rapidly affects against Gram-positives and Gram-negatives. Its activity time is long, while its toxic effect is short. Chlorhexidine is more effective in reducing staphylococcal and streptococcal cord and skin infections as well as umbilical colonization, compared to povidone-iodine and alcohol (Mcconnell et al., 2004; Mullany et al., 2006). In the study, no difference was detected between povidone-iodine and chlorhexidine considering the prevention of colonization and separation time of umbilical cord (WHO, 1999); furthermore, povidone-iodine is more cost effective.

Oishi et al. (2004) compared the use of chlorhexidine with 80% ethanol and ethanol alone; consequently, they determined the chlorhexidine with 80% ethanol more effective in preventing colonization. On the other hand, no microbial growth was detected in 85% of babies applied with chlorhexidine, and the separation time of umbilical cord was shorter. Study results are compatible with literature. Verber and Pagan (1993) compared the effects of hexachlorophene, chlorhexidine, early bath and dry cord cares on colonization rate and separation time of umbilical cord; consequently, they found a significant decrease in the colonization and a shorter separation time of umbilical cord in the babies applied with chlorhexidine. The results of the present study are part compatible with the study of Verber and Pagan (1993). It was determined that umbilical cord separated more rapidly in babies applied with chlorhexidine (p < 0.05).

Janssen et al. (2003) investigated omphalitis and colonization in newborn babies by comparing alcohol, triple dye and natural drying. E. coli, coagulase-negative staphylococci, Staphylococcus aureus and group B Streptococcus were evidently higher in natural drying method. In the present study, the examination of umbilical area wipe samples taken just after the delivery showed E. coli only in 1 baby. Subsequently, cares with antiseptic solution were applied and microbial growth was observed in the examination of the wipe samples on the fifth day. In the light of these findings, it becomes important that umbilical care with antiseptic solution should be definitely applied to newborn babies, and mothers should be informed on umbilical cord care criteria. In many studies, umbilical cord care with antiseptics was reported to reduce bacterial colonization (Stark and Harrisson, 1992; Watkinson and Dyas, 1992; Perapoch et al., 1993; Rush, 1998; Smale, 1998; WHO, 1999; Tabak et al., 2001; Janssen et al., 2003; Patricia, 2003; Mcconnell et al., 2004; Oishi et al., 2004; Weathers et al., 2004; Zupan et al., 2004; Mullany et al., 2006;
Nourian et al. (2009). This finding of the study is compatible with literature.

In addition to the care with antiseptics given at 24 h intervals following the delivery, education of mothers on clean umbilical cord care is among the reasons why the cord infection was rarely seen according to the study results.

Conclusion

In conclusion, 70% alcohol was less beneficial in preventing colonization and prolonged separation time of umbilical cord. No significant microbial proliferation was detected in the uses of 10% povidone-iodine and 0.4% chlorhexidine, and the separation times of umbilical cord were found comparable to each other and shorter compared to alcohol group. Considering the cost-efficiency, povidone-iodine seems to be more advantageous but is less practicable due to its side effects; therefore, 0.4% chlorhexidine is more suitable and could be used in clinical practice. On the other hand, alcohol is not suggested because of its inefficiency in preventing umbilical colonization, its rapid evaporation and prolonged separation time of umbilical cord.

In the studies implemented in developing countries, the use of antiseptic fluids was reported to significantly reduce colonization. In the light of the findings of the present study, newborn babies should be applied with umbilical cord care at least two times in 24 h, and the parents should be informed on the umbilical cord cares which could be applied in home; these approaches significantly reduce the colonization in umbilical area. Comparative studies with a more comprehensive and heterogeneous group considering the socioeconomic factors will be illustrative to generalize the study results to larger populations.

ACKNOWLEDGEMENTS

The authors are grateful to all the mothers and newborns who participated in this study. We are grateful to Dr. Zeynep Sumer for the assistance to perform laboratory tests. This study was supported by a grant from Department of Cumhuriyet University Scientific Research Projects (SYO-2).

REFERENCES

Rush J (1998). Cleaning the umbilical cord with water rather than alcohol shortened the time to separation with no change in colonization. Evidence-Based Nursing, 1: 112.


