Effect of Chlorhexidine Gluconate on the Skin Integrity at PICC Line Sites

Marty Visscher, PhD1, M. Victoria de Castro, MSN, RNC2, Lisa Combs, RN2, Lori Perkins, BSN, RN2, Jill Winer2, Nancy Schwegman, RNC2, Claire Burkhart, BSN, RN2, and Pattie Bondurant, MN, RN, CNS2, Skin Sciences Institute1, Regional Center for Newborn Intensive Care2, Cincinnati Children’s Hospital Medical Center, Cincinnati, OH

Introduction
The research literature on the effects of common skin care practices, e.g., cleansing, topical treatments, tapes, and adhesive tape removal, is sparse, particularly in high risk populations. NICU infants are at risk for skin breakdown due to prematurity, irritant exposure, stress, and adhesive tape removal. There is a need to minimize damage and facilitate the development of an effective stratum corneum (SC) barrier.

To reduce PICC line associated infections, the skin is treated with chlorhexidine gluconate (Chloraprep®, 2% CHG, 70% alcohol, water) before insertion and application of tapes (steri-strips) and dressings (semipermeable, e.g., Tegaderm™). However, data on the skin effects, i.e., irritation, inflammation and SC barrier integrity, is limited. CHG (0.5%) was more effective than 10% povidone-iodine against colonization, but skin effects were not reported. Severe contact dermatitis was seen in 5.7% of preterm infants treated with a CHG dressing (Biopatch®). We determined the skin effects of CHG at PICC sites among neonates in the Regional Center for Newborn Intensive Care (RCNIC) at Cincinnati Children’s Hospital Medical Center (CHMMC).

Methods

Subjects:
- Gestational age: 23 – 39 wks
- PICC insertion site in arm or leg
- Expected to have a PICC for at least 18 days
- Parent/guardian provided written informed consent

Procedures:
- Compare three skin regions: (1) PICC site treated with CHG and a semipermeable dressing (Tegaderm™), (2) contralateral site treated with dressing alone (Tegaderm™, 2.5 cm² piece) and (3) adjacent site with no treatment (control).
- Within subject design, subject is own control
- Skin evaluated at insertion and at weekly dressing changes
- Apply treatments at baseline (insertion) and weeks 1, 2, 3 to determine effects of repetitive exposure
- Measure skin irritation (erythema, dryness/scaling) and SC barrier function by transepidermal water loss (TEWL, g/m²/hr) using the VapoMeter (Delfin Technologies, Inc.)
- Assess immediate irritant response to CHG application at PICC site

Measurements:

Skin Erythema Grading Scale

<table>
<thead>
<tr>
<th>Erythema Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>No erythema</td>
</tr>
<tr>
<td>1.0</td>
<td>Slight powderiness or early cracking</td>
</tr>
<tr>
<td>1.5</td>
<td>Moderate cracking &amp; scales</td>
</tr>
<tr>
<td>2.0</td>
<td>High cracking &amp; lifting scales</td>
</tr>
</tbody>
</table>

Skin Dryness Grading Scale

<table>
<thead>
<tr>
<th>Dryness Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>No dryness</td>
</tr>
<tr>
<td>1.0</td>
<td>Slight powderiness or early cracking</td>
</tr>
<tr>
<td>1.5</td>
<td>Moderate cracking &amp; scales</td>
</tr>
<tr>
<td>2.0</td>
<td>High cracking &amp; lifting scales</td>
</tr>
</tbody>
</table>

Skin Dryness grading scale

Statistical Analyses:
ANOVA for site comparisons of erythema, dryness/scaling, TEWL, p < 0.05; appropriate pairwise comparisons (SigmaStat, SPSS). Paired t-test for immediate erythema response. Linear mixed models (SPSS), repeated measures, F statistic at p < 0.05; treatment comparisons by method of Bonferroni.

Results

Subjects:
- 45 infants
- Gestational Age: 32.1 ± 4.7 wks (range 23 – 39 wks)
- Age at Study Start: 34.8 ± 5.5 wks (range 25 – 57 wks)
- Gender: 22 males, 18 females

Immediate Erythema:

Before one week, the PICC site had a significantly higher TEWL, indicating a significantly higher (greater water loss) than both the dressing site and the control.

Erythema and Dryness:

Skin erythema immediately after CHG application (PICC insertion) was directly increased (p < 0.05), but this effect was not observed for subsequent applications.

Conclusions and Implications

- CHG does not produce an immediate inflammatory response in this clinical population.
- The dressing (Tegaderm™) contributes to the PICC site erythema and dryness observed after prolonged exposure and repeated application.
- The combination of CHG + dressing may behave as a “low water vapor permeability” cover that allows water accumulation under it. Occlusion and water exposure delays skin barrier development and repair.
- The increase in TEWL at PICC sites may result from skin stripping at the time of dressing change.
- Dressings with inherently higher water vapor permeability are expected to minimize the skin breakdown at PICC sites. Investigation of alternatives is warranted.

Disclosure
An unrestricted educational grant was received from Enturia, Inc.