Comparative Study of the Effects of MEBO, Silver Sulfadiazine, and Hot Dry-Exposed Therapy on Controlling Burn Wound Infection with *Pseudomonas aeruginosa*


The following are summary and/or excerpts of the publication. For the entire publication, please refer to the original paper.

This comparative study was designed to verify the effects of MEBO, SD-Ag, and hot dry-exposed therapy on controlling *P. aeruginosa* invasive infection in burns wounds.

**Materials and Methods:** Pathogenic *P. aeruginosa* was collected from burns wounds of invasive infection, cultured for 16-24 h, then produced into a $4 \times 10^8$ suspension using normal saline. One hundred and twenty healthy adult Wistar rats of either sex weighing 100-200 g were anesthetized intra-peritoneally with sodium pentobarbital (40 mg/kg), shaved of dorsum hair, and scalded on the back with 100°C water for 10 s to each form a full-thickness burn wound with 20% BSA (determined by pathological examination). A 1-ml suspension containing $4 \times 10^8$ *P. aeruginosa* was smeared evenly onto the wound surfaces to achieve contamination and infection. The animals were kept in separate cages, and divided randomly into 4 groups as follows (30 in each). Group 1 (control group) received no treatment. Group 2 (MEBO group) was treated with MEBO kept the wound moisturized and covered by MEBO throughout the study. Group 3 (SD-Ag group) was treated with 1% SD-Ag cold cream, which was applied once a day. Prior to each administration of the SD-Ag, the residual cream and necrotic tissue was wiped off according to the SD-Ag protocol. Group 4 was treated with continuous hot, dry-exposed therapy using a heat-controlled air fan to keep the wound dry. Six animals in each group were killed under aseptic manipulation at the 1st, 3rd, 5th, 7th and 9th days after treatment. A sample of heart blood was collected and cultured and a specimen of wound skin tissue was taken by sterile scalpel, as deep as the muscular fascia, and then cut into two parts. One part was used for bacterial count in sub-eschar viable tissue. The other was fixed in formalin for pathological examination. Sections were observed under a light microscope and the extent of bacterial invasion was classified according to three grades: ‘0’ referring to absence of bacterium, ‘I’ to invasion of bacteria to necrotic tissues, and ‘II’ to invasion of bacteria to viable tissues.

**Results:** *Bacterial Count of Sub-Eschar Viable Tissues:* Table 1 shows the mean logarithmic values of bacterial count of sub-eschar viable tissues in each group. The results indicated the mean values in groups 2 and 3 were significantly lower than those in groups 1 and 4 ($p < 0.01$). No significant difference of this value was noted between groups 2 and 3 ($p > 0.05$) or between groups 1 and 4 ($p > 0.05$).

<table>
<thead>
<tr>
<th>Group</th>
<th>Bacterial count (logarithmic value)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Mean logarithmic values of bacterial count of sub-eschar viable tissues (mean ± SE)
Correlation between Bacterial Count of Sub-Eschar Viable Tissue and Clinical Course: As figure 1 shows, the bacterial count of sub-eschar viable tissues in groups 1 and 4 increased progressively during the whole course of the disease. The bacterial count in groups 2 and 3 remained at low levels, less than $10^5/g$ throughout, and even declined, indicating that both these topical drugs were effective in controlling the proliferation of P. aeruginosa.

![Figure 1. Illustration of the correlation between bacterial count in subeschar viable tissues and the clinical course in each group.](image)

Results of Blood Culture: The incidence of positive blood cultures in groups 2 and 3 was markedly lower than in groups 1 and 4 ($p < 0.005$), as is shown in table 2. There was no significant difference of positive rates between groups 1 and 4 ($p > 0.50$), or between groups 2 and 3 ($p > 0.75$).

<table>
<thead>
<tr>
<th>Group</th>
<th>Positive number</th>
<th>Negative number</th>
<th>Positive rate,%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Blood culture</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (control)</td>
<td>25</td>
<td>5</td>
<td>88.33</td>
</tr>
<tr>
<td>2 (MEBO)</td>
<td>7</td>
<td>23</td>
<td>23.33</td>
</tr>
<tr>
<td>3 (SD-Ag)</td>
<td>8</td>
<td>22</td>
<td>26.67</td>
</tr>
<tr>
<td>4 (hot dry-exposed)</td>
<td>19</td>
<td>11</td>
<td>63.33</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>59</td>
<td>61</td>
<td>49.17</td>
</tr>
<tr>
<td><strong>Pathological examination</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (control)</td>
<td>21</td>
<td>9</td>
<td>70.0</td>
</tr>
<tr>
<td>2 (MEBO)</td>
<td>11</td>
<td>19</td>
<td>36.67</td>
</tr>
<tr>
<td>3 (SD-Ag)</td>
<td>12</td>
<td>18</td>
<td>40.0</td>
</tr>
<tr>
<td>4 (hot dry-exposed)</td>
<td>20</td>
<td>10</td>
<td>66.67</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>64</td>
<td>56</td>
<td>53.33</td>
</tr>
</tbody>
</table>
Pathological Examination: In the study, grades of ‘0’ and ‘I’ in the pathological examination were referred to as negative while grade ‘II’ was referred to as positive (table 2). Positive rates of pathological examination in groups 2 and 3 were significantly lower than those in groups 1 and 4 (p < 0.005). There was no significant difference of positive rates either between groups 1 and 4 (p > 0.50), or between groups 2 and 3 (p > 0.50).

Comparison of Incidence of Invasive Infection of Burns Wounds: According to the data that bacterial invasion to viable tissue of wound and/or bloodstream in the circulation were indicative of invasive infection of burns wounds, table 3 shows the incidence of invasive infection in each group. It was found that the incidences of invasive infection in groups 2 and 3 were dramatically lower than those in groups 1 and 4 (p < 0.005). There was no significant difference of positive rates either between groups 1 and 4 (p > 0.25) or between groups 2 and 3 (p > 0.50).

<table>
<thead>
<tr>
<th>Group</th>
<th>Positive number</th>
<th>Negative number</th>
<th>Positive rate, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (control)</td>
<td>26</td>
<td>4</td>
<td>86.67</td>
</tr>
<tr>
<td>2 (MEBO)</td>
<td>12</td>
<td>18</td>
<td>40.0</td>
</tr>
<tr>
<td>3 (SD-Ag)</td>
<td>11</td>
<td>19</td>
<td>36.67</td>
</tr>
<tr>
<td>4 (hot dry-exposed)</td>
<td>23</td>
<td>7</td>
<td>76.67</td>
</tr>
<tr>
<td>Total</td>
<td>72</td>
<td>48</td>
<td>60.0</td>
</tr>
</tbody>
</table>

Comparison of Bacterial Count of Sub-Eschar Viable Tissue and Pathological Examination for Diagnosis of Burn Wound Infection: According to table 4, there was a direct correlation between the positive rates of the bacterial count of sub-eschar viable tissue and the pathological examination ($r = 0.808$, $p < 0.005$). The positive rate of pathological examination increased as did the bacterial count. In further analysis, we took a bacterial number of $10^5$ g sub-eschar viable tissue, the level defining invasive infection, as the boundary for positive and negative. It was found by comparison that positive rates of pathological examination of tissue specimens that yielded counts of $10^5$ g sub-eschar viable tissue or more reached 74.2%. The negative rate of pathological examination of those yielding counts that was lower than $10^5$ g reached 69%. The coincidence and non-coincidence rates of two diagnostic methods were 71.67 and 28.33%, respectively (table 5). Statistical analysis showed an obvious relationship between both methods ($\chi^2 = 17.62$, $p < 0.005$) and there was no significant difference between both methods in the diagnosis of burn wound infection ($\chi^2 = 0.031$, $p > 0.75$).

<table>
<thead>
<tr>
<th>Bacterial count</th>
<th>Pathological examination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>positive number</td>
</tr>
<tr>
<td></td>
<td>negative number</td>
</tr>
<tr>
<td></td>
<td>total</td>
</tr>
</tbody>
</table>
### Table 5. Results of positive bacterial count and positive pathological examination

<table>
<thead>
<tr>
<th>Bacterial count ≥10^5</th>
<th>Pathological examination</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>positive number</td>
<td>negative number</td>
<td>total</td>
<td></td>
</tr>
<tr>
<td>Positive number</td>
<td>46</td>
<td>16</td>
<td>62</td>
<td></td>
</tr>
<tr>
<td>Negative number</td>
<td>18</td>
<td>40</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>64</td>
<td>56</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>Coincidence rate</td>
<td>86/120 (71.67%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-coincidence rate</td>
<td>34/120 (28.33%)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Conclusion:** 1. MEBO has a similar effect to SD-Ag in controlling burn wound invasive infection by *P. aeruginosa*. 2. Hot dry-exposed burns therapy has no effect on controlling third-degree burn wound invasive infection by *P. aeruginosa*. 3. The bacterial count of sub-eschar viable tissue can still be used as one of the feasible methods in the early diagnosis of burn wound invasive infection.