Clinical Experience of Acticoat™ Treatment in Extensive Burn Wounds

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ABSTRACT

Acticoat™ (Smith & Nephew, Hull, UK) is a relatively new form of silver antimicrobial barrier dressing produces a moist healing environment along with the sustained release of ionic silver for improved microbial control. The benefits of acticoat in the management of extensive burn wounds have been well established. Acticoat has been reported to reduce wound infection and promote healing. No evidence has emerged of resistance or cytotoxicity to acticoat. Given these potential advantages, we have used acticoat in a variety of treatment of extensive burn wounds at burn unit, Siriraj Hospital during September 2002-May 2005. We reviewed with attention to wound etiology, % of organism colonization, efficacy and cost effectiveness. Due to its long lasting properties led to less frequent dressing changes and reduce trauma and pain to burn patients. It is particularly benefit to patients who suffered from partial thickness burn wound especially in children and high % of total body surface area (TBSA) patients (>15%). Acticoat treatment in extensive burn wounds also confirmed its efficacy, low labor cost set up and cost effectiveness compared to conventional dressing with silver zinc sulfadiazine.

Keywords: Acticoat™ Silver Zinc Sulfadiazine (Siriraj Burn Cream)

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Silver is an effective antimicrobial agent that has been used in the clinical setting over a century. One of common topical antimicrobial used in treatment of burn wounds is silver nitrate but it can cause tissues irritation and also causes a significant amount of staining of virtually any surface with which it comes into contact. Wound fluid can be inactivated the silver in silver sulfadiazine and cause pseudo-eschar formation. Both silver nitrate and sulfadiazine are also limited in the clinic due to the need for a high frequency of application. Siriraj burn wounds have been using silver zinc sulfadiazine for over two decades to replace the previously used silver sulfadiazine cream.

Acticoat (Smith and Nephew USA, Largo, FL) is a silver-impregnated membrane designed to overcome the limitations. It composes of high-density polyethylene mesh which is covered to either side of a rayon-polyester core (Fig 1). The rayon polyester core will absorb coagulum exudates and retain wound moisture. The coated silver will be activated by the use of sterile water and consumed by interaction with target cells or inactivated protein and anion complexes in wound fluid, additional silver is released, thus producing a sustained, steady supply of active silver.

Extensive pre-clinical burn wound studies have demonstrated that acticoat has a broad spectrum against over 156 pathogens. The mode of its antimicrobial action includes respiratory enzyme poisoning, inhibition of protein synthesis and inhibition of DNA replication of bacteria. In vitro study, the antimicrobial activity of acticoat was compared with other burn topical antimicrobial agents and showed better result (Fig 2).

This study had demonstrated that acticoat dressing protected and prevented the wound from traumatic infection and pain. It also proved the cost effectiveness in overall treatment cost and reduce nursing time. The quality of life of the patient had remarkably improved due to fewer dressing change as compare to conventional treatment.

MATERIALS AND METHODS

Study design

This study reviewed our preliminary clinical experience in the use of acticoat in the treatment of 60 extensive burn wound patients admitted to Siriraj Hospital Burn unit during September 2002-July 2005. Demographic information was obtained including patient age, gender, wound etiology, %TBSA burn, length of hospital stays, and mortality.

Patient were also reviewed for documentation of
Fig 1. Acticoat (Nanocrystalline silver) is the antimicrobial agent being applied to high-density polyethylene mesh which is covered to either side of a rayon-polyester core.

efficacy and cost effectiveness compared to dressing wound with silver zinc sulfadiazine. When available, patient photographs were also reviewed for subjective evaluation of cosmetic and function outcome of treatment partial thickness burn wound with acticoat nanocrystalline dressing.

Wound dressing protocol

All patients who involved in this study had partial to deep secondary degree burn. Acticoat has been used in all patients from the beginning through out the wound healing period. The burn wounds were underwent cleansing with sterile water and dried up with gauze followed by dressed up the wound surface with acticoat soaked with sterile water. The acticoat was held in place by a cotton gauze wrapping (Fig 3A-E).

Acticoat dressings were then wet with sterile water every six hours daily in order to maintain moisture and promote wound healing (Fig 4A,B). On every 3 days, Acticoat was removed at the bedside and the burn wounds were inspected by experienced burn surgeon for the presence of sign of wound infection then new acticoat dressings were replaced and inspected every third day until wound closure was completed.

The inspection and swab culture of the burn wound was taken regularly twice a week. Surgical procedures such as escharotomy, fasciotomy, early performed tangential excision of the deep burn eschar mostly were carried out at the first few days post injuries if it’s possible, but the eschar with the softening and began to separate. It could be easily removed by the assistance of the debrider or sharp instrument like scissors.

Systemic antibiotic was started based on apparent signs/symptoms of local infection, heavy colonization of bacteria cultures in burn wounds higher than 10^5 colonies/gm. of tissue or otherwise clinical manifestations were present.

RESULTS

There were 60 burn patients, 47 male, 13 female, average age 36 ± 20 years (6 months-80 years), %TBSA burn 38 ± 25 (4-95%). All burn wounds in this study were partial thickness secondary degree burn. The causes of injury were 41 flame, 12 scald, 6 electrical and 1 chemical burn wounds. The average length of hospital stay was 38 ± 41 days. 4 patients (mortality rate 6.6%) died from multiorgan failure. The 31 patients (52 %) were treated previously with sulfadiazine before switched to acticoat dressing due to they were referred from other hospital. 8% of patients who were treated with acticoat at first had to be switched to the other topical antimicrobial agent due to wound surface seem to be unpleasant. 18 patients (30%) required skin graft to close the open wound area and after first autograft all area healed without the need for regrafting. 5 patients who died had major burn more than 65% TBSA (65%, 70%, 85%, 92%, 95%).

No severe burn wound sepsis was observed. All burn patients (100%) treated with acticoat have no serious infection and response well to systemic antibiotic treatment. The survivor with the greatest % burn was 90% TBSA.

The overall cost was cheaper than the conventional
method (Table 1). The patient’s quality of life also showed great promise. Some species of bacteria could be detected from wounds of some patients even though the wounds were treated with acticoat. 52.8% of the wounds treated with acticoat demonstrated positive cultured organisms. But most patients demonstrated few to no growth of bacteria of them (46.6% and 47%, respectively). The group of gram positive cocci was most frequently detected in our patients, mostly occurred right after the new wound healing when the burn wound had healed and new multiple small superficial ulcerations appeared on top of those new healing burn wounds. We did not believe that this happening was concerned with the use of acticoat dressing only because this similar event has happened in the past during or after the use of silver zinc sulfadia-

zine cream. The frequency of microorganism, detected from the burn wounds surface by wound swab culture were shown in Fig 5A-C.

DISCUSSION

From our clinical experience of acticoat in the treatment of extensive burn wound patients, we have learned several things. First of all, acticoat dressing was not started at the beginning right after burn injury to all of these patients. The reason was due to the fact that most of our burned patients were initially treated from somewhere else before they were referred to our burn unit. Therefore, the changes in wound appearance could be observed only after the period of acticoat treatment. Sometimes we have to switched acticoat to the other topical antimicrobial agent due to patient’s expense or wound surface seem to be unpleasant. Fortunately, most patients 40 (67%) have started acticoat treatment in the early period of burn wound (within 7 days postburn), we enable to observe the changes of wound healing under the coverage of acticoat until burn wound closure.

We were quite impressed in many patient’s wound which wound healing have completed. The examples of case reports of patients treated with acticoat were demonstrated below.

Case reports

Patient histories from a representative sample of patients is listed below.

Table 1. Comparison of total expenses between conventional procedure and Acticoat (in Baht)

<table>
<thead>
<tr>
<th>Description</th>
<th>Acticoat</th>
<th>Conventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cost of primary dressing (Baht)</td>
<td>58,921</td>
<td>22,800</td>
</tr>
<tr>
<td>Total cost of 2nd dressing (Baht)</td>
<td>1,704</td>
<td>35,712</td>
</tr>
<tr>
<td>Labor cost (Baht)</td>
<td>2,404</td>
<td>7,214</td>
</tr>
<tr>
<td>Total cost of treatment (Baht)</td>
<td>63,029</td>
<td>65,726</td>
</tr>
<tr>
<td>Time to heal</td>
<td>24 days</td>
<td>Est. 24 days</td>
</tr>
</tbody>
</table>

Note: Labor cost was direct nursing care cost at Siriraj Hospital. Physician consultation and others cost were not included.

Fig 5A-C. Frequency in percentage of type of microorganisms (a), degree of wound colonization (b) and positive cultured organisms (c) detected from the burn wound swab culture in 210 swab cultures taken from 60 patients at the period prior to the next set of acticoat application.
Patient 1
This case demonstrated a 4-year-old girl with a 40% TBSA secondary degree scald burn. We know that generally child burn is quite difficult to deal with. This case demonstrated the benefit of Acticoat in management of bleeding burn wound surface after treated with topical silver sulfadiazine. In this case, Acticoat was able to control overgrowth of hypergranulation tissue and reduce bleeding from trauma and infection of wound surface. We found that Acticoat dressing (change every 3 days) has markedly benefit in child than conventional treatment due to less frequent dressing change, less pain hence less trauma. Patient’s compliance also markedly improved. The effect of Acticoat on hypertrophic scar has to be followed up in long term (Fig 7A-E).

Patient 2
A 35-year-old male was seriously flame burn injury and has a deep secondary degree burn in the majority part of posterior aspect of the torso and the four extremities roughly 45% of his total body surface area. This burns were covered with sheet of Acticoats and the patient required less frequent dressing changes as compare to conventional treatment with silver sulfadiazine (SSD). The Acticoat dressing protected and prevented burn wound from repetitive trauma, infection and pain. It was anticipated that the dermal burn to the back, posterior aspect of extremities would have to be excised and grafted, but after Acticoat treatment on the burn wounds significant healing was seen. After 6 weeks, the wound was completely re-epithelialized with minimum disturbance to the patient (Fig 7A-E).

Cost effectiveness analysis between Acticoat and silver zinc sulfadiazine were also performed in this patient. We found that total expenses of conventional procedure was higher than Acticoat treatment. Acticoat proved to provide cost effectiveness in overall treatment cost and reduce burden of nursing time (Table 1).

Patient 3
A 55-year-old male diagnosed 65% TBSA Toxic epidermal necrolysis (TEN) at 4 limbs and trunk. Generally, pattern of skin involvement in TEN is similar to superficial secondary degree burn. All wound area healed within 15 days after using Acticoat. This suggest that Acticoat also useful in treatment of TEN (Fig 8A-D).

CONCLUSION
Acticoat is an effective new antimicrobial barrier wound dressing produced by Nanotechnology. Acticoat is not only useful in treatment of burn wound but also proved effective in chronic wounds and difficult skin loss conditions such as in TEN. Due to its long lasting properties led to less frequent dressing changes, it is particularly benefit to special group of patients who suffered from partial thickness burn wound especially in children, high% of TBSA patients (>15-20%). Experiences of Acticoat treatment in extensive burn patients confirmed its efficacy, low labor cost set up and cost effectiveness.

REFERENCES
ประสบการณ์การรักษาแผลไฟไหม้หน้าผากขาด ชนิดบริเวณกว้างด้วยแผ่นปิดแผลเคลือบกัน

ผลิตภัณฑ์ Acticoat (Smith & Nephew, Hull, UK) เป็นวัสดุที่มีผลต่อการก่อแบบค่อนข้างใหม่ที่มีอยู่ในระบบในการป้องกันการติดเชื้อ ทำให้ลดความซึ้งซ้อนให้กับผู้ป่วย ความสูงเกินกว่ากระดูก ประกอบด้วยโครงสร้างของผิวที่มีการควบคุมการเจริญเติบโต ซึ่งเป็นผลลัพธ์ของ Acticoat ในกระบวนการก่อ

ปิดแผลไฟไหม้หน้าผากมีการศึกษาอย่างแพร่หลายของผลกระทบที่มีปริมาณสูงกว่า ได้มีการรายงานว่า Acticoat สามารถลดการติดเชื้อและส่งเสริมการหายของแผล

ไม่มีหลักฐานว่าการติดเชื้อและการเป็นพิษจากภูมิลักษณะ Acticoat ด้วยข้อมูลที่มีว่า Acticoat ทำให้การศึกษาในการรักษาแผลไฟไหม้หน้าผากขาด หลาย ๆ

ชนิดไม่เพียงให้กับผู้ป่วยได้ ของทรีเวล ช่วงระหว่างเดือน กันยายน 2545 - กรกฎาคม 2548 โดยมุ่งความสนใจในการศึกษาไปที่ wound etiology, % organism colonization, ประสิทธิภาพ และความคุ้มค่าของมันทุ่มในการรักษา สารประกอบที่มีอยู่ในกระบวนการดังกล่าวซึ่งมีผลต่อการลดการติดเชื้อที่ต่ำกว่าจานบาง มีผลต่อการ

ลดจำนวนความที่เกิดขึ้นลดการผลิตของพิษและข้อมูลเพิ่มขึ้นกว่าทุกข้อมูลของส่วนใช้จากทางเดี่ยว ทำให้ Acticoat มีข้อติดการ

รักษาโดยเฉพาะอย่างไรในผู้ป่วยไฟไหม้มีการกระชับ (partial thickness burn) ในเด็กและหญิงที่มี % ของ total body surface area (TBSA >15%) การศึกษา Acticoat นี้มีข้อมูลเพิ่มประสิทธิภาพในการรักษาผู้ป่วยไฟไหม้หน้าผากแผลรักษาซึ่งมีอัตราบริเวณที่มากกว่าและประสิทธิภาพถึงต่ำกว่าใช้ข้อมูลที่ปรับเพิ่ม

กันการรักษาด้วย silver sulfadiazine แบบเดิม ๆ