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A randomized comparison study of Aquacel Ag and Alginate Silver as skin graft donor site dressings

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ABSTRACT

Objective: This study was conducted to compare pain, healing time, infection rate, and cosmetic outcome between Aquacel Ag (convatec) and Alginate Silver (coloplast) as donor site dressings.

Materials and Methods: We conducted a prospective randomized controlled trial of donor site dressings, comparing Aquacel Ag with Alginate Silver. Patients were randomly allocated to donor site dressing with one of these materials. Outcome measures included pain scores at rest and during dressing changes, time to re-epithelialization, cosmetic outcome and infection rate. Results were assessed for significance using the independent *t*-test (non-parametric data) and the chi-square test (parametric data).

Results: A total of 20 subjects were enrolled in this study. Subjects included in both groups were comparable with no significant differences in demographic data of age, gender, location of burn and type of burns ($P > 0.05$ evaluated by paired *t*-test) between both group. The pain scores were found to be higher in Aquacel Ag group than in Alginate Silver group. Time to re-epithelialization was longer in Aquacel Ag group than in Alginate Silver group. There were no significant differences between the two treatment groups with respect to cosmetic outcome and infection rate.

Conclusions: Based on these results, we find that Alginate Silver is better than Aquacel Ag to cover the skin graft donor site.

Split-thickness skin grafting is an important medical treatment in plastic and burn surgery. After the skin was harvested, the donor site will be left uncovered. Donor site is often painful and prone to infect if wound exudates is not contained by the dressing [1]. And the donor sites can also lead to acute and chronic complications, including hypertrophic scarring and pigmentation irregularities. There are kinds of dressings reported to be used in the donor site, but which one is the best donor site dressing is still a problem to be solved [2]. The best dressing should provide an optimal environment for reepithelialization while simultaneously preventing infection, minimizing patient discomfort, and promoting a quality cosmetic outcome. In our unit, we have used several kinds of donor site dressings. Such as vaseline gauze, alginates, Aquacel Ag, hydocolloids and biosynthetic skin substitutes. We have found that in these dressings Aquacel Ag and Alginate Silver are among the best.

Although Aquacel Ag and Alginate Silver have been used for a while, there are little data regarding comparisons of these two materials. Aquacel Ag is an absorbent wound dressing made from sodium carboxymethyl cellulose and impregnated with 1.2% silver. It is a moisture retentive topical dressing which can release silver within the dressing for up to 14 days [3]. Alginate Silver is a material contains calcium alginate and silver alginate. It is a highly absorbent wound dressing with good antimicrobial properties, which is similar to Aquacel Ag

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[4]. In order to find the different effects of these two materials on skin graft donor site, we conducted this prospective study.

1. Patients and methods

We performed a prospective, randomized, patient controlled study. This study was designed to be open-labeled and observer-blinded. This study was proved by ethics committee of the hospital affiliated to Jiangsu University. Informed consent was obtained from each patient enrolled in the study. A total of 20 patients were enrolled in this study. Individual patients were identified in the Aquacel Ag ($n = 10$) or the Alginate Silver group ($n = 10$). The patient population consisted of 20 compliant adults, with 5–30% TBSA full-thickness skin loss. Split-thickness skin grafting procedures were performed on these patients for the management of full-thickness skin loss due to burns, trauma or surgery. Comorbidities in this series included hypertension ($n = 5$), peripheral vascular disease ($n = 3$), and diabetes ($n = 2$).

The skin graft was harvested from back, thigh, or chest with a hand knife. All donor sites had not previously been harvested for skin grafts. Immediately after harvest, the donor site was covered with 1:10,000 epinephrine–saline-soaked gauze for homeostasis until surgery was completed. The donor area was then divided into 2 equal parts, with the left half marked area A and the right half marked area B. Each area spanned at least 8 cm × 10 cm. In each group, Aquacel Ag or Alginate Silver was put to one of these areas randomly. Vaseline gauze was then covered with gauze pads on the top. Finally we bandage these dressings to prevent them from moving to other places.

Standard procedures for each donor site were employed by staff in our burn unit. All subjects were hospitalized in our department, with bed rest restriction after the skin grafting. The dressing of the donor site remained intact for 3 days postoperatively. In the third day after surgery, we opened the external dressing and changed the Aquacel and alginate. From that day on, we opened the external dressing in the interval of 2 days. The amount of exudates and the signs of infection were checked. If there was too much exudate, the dressings were changed.

While in the hospital, the subjects were followed on postoperative days 1, 3, 6, 9 and 12 for pain assessments and photos. Pain was assessed using a numeric pain scale from no pain (0) to maximum pain (10) and recorded on postoperative days 1, 3, 6, 9 and 12. The subjects were requested to report the pain for each donor site, and these scores were recorded and compared.

The donor sites were assessed at 1, 3, and 6 months postoperatively for scarring using a modified Vancouver Scar Scale (mod VSS). The donor sites were digitally photographed at these intervals as well.

A donor site follow-up chart was used for conducting the clinical follow-up of the healing process. The information gathered in the chart included the percentage of epithelialization of each donor site area, the state of healthy skin on the periphery of each donor site. Donor sites were also assessed for evidence of infection (cellulites, drainage, and exudates). If, at any time, the donor sites presented with clinical signs and symptoms of infection, such as erythema and/or drainage, the dressing was removed and swab cultures were obtained for analysis. Cultures were sent from wounds that were suspicious for infection. The chart was filled in by a single treatment-blinded observer on postoperative days 3, 6, 9 and 12 when the dressing fell off. Wounds were considered to be completely reepithelialized when there was no residual exudates and with no pain when the site was exposed to air.

Independent *t*-test was employed to test the difference between the two dressing groups in quantitative variables. I.e., day of complete re-epithelization, pain scores, and scar scale. The chi-square test was performed to assess the differences in the incidence of adverse effects between treatment groups. A two-sided *P* value of less than 0.05 was considered statistical significance.

2. Results

There were 20 patients recruited in our study, demographic data is shown in Table 1. The mean age of patients in Aquacel Ag group was 37 years while in Alginate Silver group mean age was 39 ($P = 0.708$).

The mean time to healing under Alginate Silver was shorter than Aquacel Ag ($P < 0.02$). Aquacel Ag-treated areas were reepithelialized completely in 7.96 ± 0.36 days. The Alginate Silver treated group need 7.01 ± 0.43 days to reepithelialize.

Pain scores for postoperative days 1, 3, 6, 9, and 12 are shown in Fig. 2. The Aquacel Ag group had manifested significantly more pain scores than the Alginate Silver group in days 3, 6, and 9 ($P < 0.02$).

Patients were seen postoperatively at 1, 3, and 6 months to assess cosmetic outcome (Fig. 3). Using the mod VSS scores, there was no statistically significant difference between the donor dressings ($P > 0.05$).

Data regarding adverse effects is shown in Table 2. Two patients (20%) had leakage of wound fluid from the edge of the dressing because of inadequate adherence of the bio-occlusive dressing. Three patients presented with clinical evidence of donor site infection (15%). Surrounding erythema and excessive drainage prompted dressing removal in all three cases.

Table 1 – Patient characteristics.

	Aquacel Ag ($n = 10$)	Alginate Silver ($n = 10$)
Mean age	37.2 ± 11.0	39.0 ± 10.1
Gender		
Male	6	7
Female	4	3
Type of surgery		
Burn	50%	60%
Plastic	50%	40%
Location of donor site		
Upper limb	30%	50%
Lower limb	40%	30%
Hand	10%	10%
Other	20%	10%

Table 2 – Adverse effects of these two materials.

	Aquacel Ag (n = 10)	Alginate Silver (n = 10)	P (chi square)
Infection rate	20%	10%	$P > 0.05$
Seroma rate	0%	0%	

Wounds reevaluated 7 days postoperatively. Three patients (15%) required an additional dressing. All wounds were healed (reepithelialized completely, requiring no further dressing change) by postoperative day 10 (Fig. 1). There were no instances of hematoma or seroma.

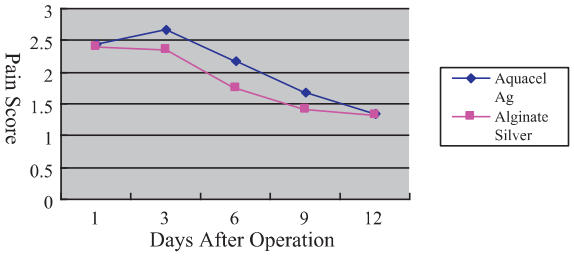

Fig. 2 – Average pain score.

3. Discussion

Skin donor site treatment is an important technical used in plastic and burn surgery. Several kinds of dressings have been reported to be used, but which is superior has not been determined [5]. There is an agreement that the optimal dressing should maintain a moist environment and support rapid healing without adhering to the wound bed [6]. It needs to be absorbent and easy to apply and remove. Feelings of the patient, cosmetic outcomes, and cost effectiveness are also relevant issues.

Aquacel have a component of carboxymethyl cellulose with a superior absorption component that aids in the healing process by providing an optimally moist environment. It was found to form a fibrin layer between the dressing and the wound, creating a physical barrier that retains cytokines, particularly intrinsic growth factors. The dressing can be overwhelmed with fluid if the subcutaneous tissue has been infused with saline and/or epinephrine before donor site harvesting [7].

It is well known that when alginate fibres are in contact with wound exudates, the calcium ions in the fibers exchange with sodium ions in the fluid, and the fibers are transformed from water-insoluble calcium alginate into water-soluble sodium alginate, resulting in the absorption of a large amount of water by the fibrosis [8]. It was also reported to act as haemostatic agents secondary to release of calcium ions for the clotting cascade and to form a gel–fiber matrix that facilitates clotting and allows for trauma-free removal of the dressing [9]. In a wound dressing, typically with a non woven structure, as the fibers absorb water and swell, the spaces between the fibers are closed and any bacteria that is carried in the wound exudates is trapped in the wound dressing. This can help reduce the spreading of bacteria, giving the alginate wound dressings bacteria static properties [10].

Based on our study, the pain feeling of Aquacel Ag was more severe than Alginate Silver. The explanation may be that when absorbed with water, Aquacel Ag would contract. So the stimulus of nerve ending was more severe than that of alginate. Beside this, we suppose that the Alginate Silver is mainly composed of calcium alginate, which will promote the coagulation of blood. The donor site will stop bleeding soon after the applying of the Alginate Silver [11]. The clot of blood formed in the Alginate Silver may be thinner and softer than that in Aquacel Ag. This will benefit the pain feeling of the donor site [12].

The average healing time under Alginate Silver was shorter than Aquacel Ag, but the mechanism is not clear. But we speculate that this effect can mainly be attributed to more cytokines remained in Alginate Silver. The time of changing dressing in Aquacel Ag group was more often than in Alginate Silver group, so most of cytokines were removed from the wound. Based on this presumption, we assume that if two layers of Aquacel Ag were used, the result would be different.

We found that the cosmetic outcomes between these two materials were not very different. But the appearance would be bad when there was an infection. To prevent this from happening, we must assure that the operation was done without bacterial.

The infection rates of these two materials were not very different. But the concentration of silver ions in Alginate Silver is 1.7%, compared with 1.2% in Aquacel Ag [10]. And the silver in Alginate can be released for over 7 days, whereas in Aquacel Ag the silver can be released for up to 14 days. After Aquacel Ag was contacted with water, its fibers hydrate and swell to form a cohesive gel structure. The formation of a cohesive gel by swollen Aquacel fibers

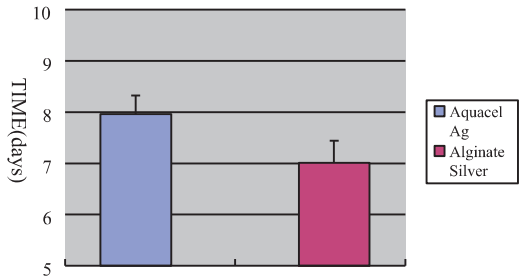

Fig. 1 – Mean time (days) to full wound reepithelialization.

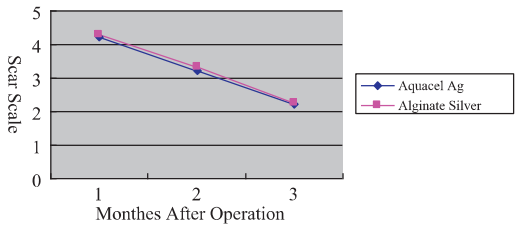

Fig. 3 – Modified Vancouver Scar Scale averages.

reduces the interstitial space within the wound dressing, which in turn blocks further fluid flow along the fibers, thereby resulting in bacterial immobilization within the Aquacel wound dressing. This is in contrast to Alginate wound dressings, which appear to produce much weaker gels due to ionic interactions. There will be less bacterial trapped in Alginate than Aquacel fibers [13].

There are differences in the nursing care for these two materials. As the Aquacel Ag is tending to move to other places, strict bed rest is needed. However, less nursing was required because the Alginate Silver tended to adhere to the healing wound after the amount of exudates was reduced. Attributed to the different in hydrophilism, the appearance of these two materials should be checked every day. As the Aquacel Ag and Alginate Silver were not transparent, removal of the dressings on postoperative day 8 was the only way to determine complete reepithelialization. Another problem inherent to investigating donor site healing sequence involves the inability to continually monitor it. Frequent inspections of the wound to assess epithelialization may damage the regenerating tissue.

The prices of these two materials are also different. One 10×10 in sheet of Aquacel Ag costs approximately $52, whereas a 10×10 in sheet of Alginate Silver costs approximately $45. Considering that the number of Aquacel Ag used would be more than Alginate Silver before the wound heeling, The Alginate Silver was more cost-benefit.

Based on the findings of the current study, we conclude that the Alginate Silver is a preferred dressing for split thickness donor site areas than Aquacel Ag. However, this study was only a preliminary research. A large scale study or a multicenter study will be done for our further study.

Conflict of interest statement

The authors have no other conflict of interest to declare for this work.

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