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ORIGINAL ARTICLE

Evaluation of Amniotic Membrane Effectiveness in Skin Graft Donor Site Dressing in Burn Patients

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Abstract Although the recipient site in burn wounds is dressed with universally accepted materials, the ideal management of split-thickness skin donor sites remains controversial. The aim of our study is to compare two methods of wound dressing in donor sites of split-thickness skin graft in patients undergoing burn wound reconstructive surgery. Forty-two consecutive patients with second- and third-degree burns with a total body surface area between 20 and 40 % were enrolled in this randomized clinical trial conducted in Motahari Burn Hospital in Tehran, Iran. In each patient, two anatomic areas with similar features were randomly selected as intervention and control donor sites. The intervention site was dressed with amniotic membrane, whereas the control site was treated with Vaseline-impregnated gauze. Wounds were examined daily by expert surgeons to measure the clinical outcomes including duration of healing, severity of pain, and infection rate. The mean ± SD age of patients was 31.17±13.72 years; furthermore, burn percentage had a mean ± SD of 31.19±10.56. The mean ± SD of patients' cooperation score was 1.6±0.79 in the intervention group compared with 2.93±0.71 in the control group, revealing a statistically significant difference ($P<0.05$). Duration of wound healing was significantly shorter ($P<0.05$) in the intervention group (17.61±2.56 days) compared with the control group (21.16±3.45 days). However, there was no significant difference in terms of wound infection rate between donor sites in the control and intervention groups ($P>0.05$). Amniotic membrane as an alternative for dressing of skin graft donor sites provides significant benefits by increasing patients' comfort via diminishing the number of dressing changes and facilitating the process of wound healing.

Keywords Burn wound · Split-thickness skin graft donor site · Amniotic membrane

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Introduction

Despite universal consensus in the applied dressing for graft recipient site, the ideal management for split-thickness skin graft donor site still remains under debate [1–4]. The applied materials and methods for wound dressing should provide adequate coverage to the donor site so that the wound rapidly reepithelializes spontaneously and to prevent the development of complications while giving the patient a state of physical and mental well-being during the healing process [5–7].

Amniotic membrane has been recently proposed as a cost-effective material for wound dressing [8]. As it originates from ectoderm, its features are similar to human skin and hence could prevent dehydration, trauma, and associated infection commonly observed in disrupted skin wounds [9, 10].

Although many experts have already tried different dressing materials for treatment of split-thickness skin graft donor site [1–7], efficacy of amniotic membrane has not already been well documented. Our study, hence, aimed to compare the effectiveness of amniotic membrane with routine methods of wound dressing for split-thickness skin graft donor site in victims of skin burn injuries.

Materials and Methods

A prospective randomized clinical trial was conducted between February 2009 and October 2009 in Motahari Burn Hospital, which has the highest referrals for burn injuries annually in the country and which is affiliated to Tehran University of Medical Sciences in Tehran, Iran. Patients with deep second- or third-degree burn wounds and a total burn surface area (TBSA) between 20 and 40 % were eligible to enter the study. Exclusion criteria were as follows: positive status of blood-borne viral infection including hepatitis B virus, hepatitis C virus, and HIV. Depth and width of the wounds were assessed by a senior medical staff in the emergency department, and an initial survey was then performed to assure stability of the patients' general condition; wounds were subsequently covered with standard dressing, and then the patients were admitted to the hospital for close observation. On the following day of admission, the wound site was prepared for engraftment by performing adequate excision and debridement to reach a viable bed. Each patient underwent a standard split-thickness skin grafting for coverage of the burn wound. Two distinct areas with similar dimensions and thickness were demarcated in donor sites of harvested split-thickness skin graft as intervention and control groups.

Intervention and control sites were both excised with a thickness of 0.016–0.24 in. (0.4–0.6 mm) by an electric dermatome with equal surface in each group; bleeding was then controlled with 1–50,000 epinephrine on a sterile gauze. One of the donor sites was then randomized to be covered with amniotic membrane (intervention group), whereas the other site (control group) was covered with conventional dressing, i.e., gauze impregnated with topical Vaseline.

The amniotic membrane was obtained from healthy seronegative mothers with no previous history of infectious disease, voluntarily donating their tissue. Umbilical cord blood was also tested for transmissible infectious diseases to assure sterility of the donated amniotic membranes. Following meticulous isolation of the amniotic membrane from the placenta, it was washed several times with normal saline and sodium hypochlorite 0.05 % and then dried to be transferred to the laboratory for further processing of sterilization and radiation with gamma waves (25 kGy).

After covering the donor site with prepared amniotic membrane, it was tried not to leave any bubbly gap between the two layers to impede development of hematoma or infection. Subsequently, a sterile gauze was applied over the biological dressing. On the other hand, control sites were dressed directly with Vaseline gauze. Both demarcated donor sites were examined daily by expert surgeons and trained nurses in terms of collections and signs of infection. While control sites were refreshed every day with normal saline irrigation and redressing with Vaseline gauze, avoiding detachment of the last-adhered layer over the wound surface, intervention sites remained persistently covered with amniotic membrane. In both the groups, with distinct patterns of dressing of the skin graft donor site, monitored wound dressing continued until the donor site wounds were epithelialized and the dressing fell spontaneously.

The following parameters were checked for each donor site: wound site infection was defined as presence of any signs of infection including discharge, discoloration, and cellulitis in surrounding tissue confirmed by wound culture revealing at least 10^5 colonies of a single microorganism.

Patient tolerance in changing the wound dressing and examining the wound site was checked by trained nurses, and the score was measured by allocating the corresponding score as mentioned in Table 1 to each condition. Because both the intervention and control groups were located in a single patient, performing a blinded procedure and application of visual analog score was not possible in this study. However, the scoring method, as described in Table 1, has already been suggested to be of benefit in the measurement of patients' pain in burn injuries [11, 12].

Duration of wound healing was also measured by the surgeon within a period of 4 weeks after initial grafting. Wound healing was defined by reepithelialization of the wound determined by spontaneous detachment of the wound dressing or scaling of the amniotic membrane. The underlying tissue hence revealed no more granulation or fibrous tissue.

All of the patients were aware of the research project and filled an informed consent before entering the study. The Research and Ethics Committee of the Tehran University of Medical Sciences approved the study protocol. The study

Table 1 Scoring scale for measurement of patient's cooperation in exchanging the wound dressing

Patient cooperation	Score
Good cooperation	1
Verbal avoidance	2
Intermittent resistance	3
Regular aggression and vigorous behavior	4
Need for an intravenous analgesic	5

was then conducted under the supervision of surgeons and expertise in the Motahari burn care center in Iran.

Data were analyzed by the Statistical Package for Social Sciences (SPSS Inc., version 16, Chicago). An independent sample *t* test for quantitative variables and Fisher's exact test for nonparametric variables were applied, and the values were considered significant at $P<0.05$.

Results

A total of 42 patients were allocated in our randomized clinical trial during the study period. Of these, 30 were male (71.43 %) and 12 were female (28.57 %). Mean ± SD age was 31.17±13.72 years; mean ± SD TBSA was 31.19± 10.56 cm^2, and that of the grafted surface was 20.60± 5.47 cm^2 in the study population. Flame was the most common cause (92.86 %) of burn injuries, and burn wounds were deep in 60.53 % of the subjects, while it was a combination of superficial and deep thickness in 39.47 % of the patients (Table 2).

Thighs were the preferred site of skin donation in 40 (95.2 %) of the patients; the left thigh was dressed with amniotic membrane in 20 of these subjects, whereas the right thigh was dressed with the routine method. In contrast, other 20 cases had an inverse pattern of wound dressing. The remainder of the burnt patients was dressed with amniotic membrane and with routine method each in their two donor sites (Table 2).

Table 2 Demographics and primary characteristics of the wound site

	Mean±SD or percent (%)
Age	31.17±13.72
Gender	
Male	30 (71.43 %)
Female	12 (28.57 %)
TBSA[a]	31.19±10.56
Grafted surface	20.60±5.47
Causes of burn	
Flame	92.86 %
Other	7.14 %
Depth of wound	
Superficial	39.47 %
Deep	60.53 %
Donor site	
Thigh	40 (95.2 %)
Other	2 (4.8 %)
Wound dressing	
Amnion	21 (50 %)
Routine	21 (50 %)

[a]Total body surface area

The score of a patient's cooperation was 1.6±0.79 in the intervention group compared with 2.93±0.71 in the control group, revealing a statistically significant difference ($P<0.000$) (Table 3). On the other hand, duration of wound healing was measured to be 17.61±2.56 days in the amniotic dressing group compared with 21.16±3.45 days in the group with the routine method; the difference was also statistically significant ($P<0.000$) (Table 3). In terms of surgical wound site infection, only two donor sites dressed by the routine method had a clinically and laboratory-confirmed infection, which did not differ statistically significantly ($P>0.05$) with that of the amniotic group (Table 3).

Discussion

The amniotic membrane for the first time was used as a substitute for skin in 1910 [13]; 3 years later, it was placed over small defects of skin wounds [14]. Although a century has passed so far, there are still challenges ahead for surgeons for wide application of this material as an acceptable wound dressing [11]. The road narrows when attention is paid to the ideal coverage for split-thickness skin graft donor sites. Various materials have been developed for dressing of these donor sites. However, despite these advances, the practice contributes to controversies at the bedside [15]. The ideal dressing option for a split-thickness donor site graft is expected to decrease healing time, reduce wound infection rate, and assure more patient comfort [7].

A major concern is the probability of infection at the donor site, which may convert a partial defect to a full-thickness skin loss, which equals a third-degree burn [16]; hence, application of antibiotic dressing over the wound site has been considered critical while it should not interfere with the healing process [17]. Epithelialization completes faster when a wet environment is provided at the wound site [18–20]. Furthermore, by using a closed dressing, dehydration, trauma, and contamination are less probable to develop [18, 21]. Occlusive dressings are also thought to prevent exposure of damaged nerve endings of the donor site to air and decrease accumulation of metabolites, resulting in diminished pain sensation [22, 23].

Our results showed that pain score was greater in the control group than the intervention group, representing a

Table 3 Outcomes of surgical wound dressing

	Amniotic membrane	Routine method	*P* value
Patient's cooperation in changing the wound dressing	1.6±0.79	2.93±0.71	<0.000
Duration of wound healing	17.61±2.56	21.16±3.45	<0.000
Wound infection	0	2	>0.05

better cooperation when amniotic dressings were exchanged in comparison with the routine dressings. Less pain sensation during removal of wound dressing has also been pointed out in the literature [24, 25] with special emphasis on the fact that an open wound coverage loses its pliability when it dries, imposing more pain [24]. In contrast, a moist environment in an occlusive dressing facilitates feasible removal of the wound coverage accompanied by milder trauma to the newly formed delicate epithelial layer. Due to the disturbing effect of pain in management of burn patients, a comfortable wound dressing would result in better cooperation by relieving the pain. Adly and colleagues [26] in their study have reported fewer needs to the exchange of wound dressing when the amniotic membrane has been applied. This was also observed among the intervention sites in our study. This benefit could probably decrease the pain that is sensed by the patients during dressing change.

Duration of wound healing was shorter in the amniotic membrane group. The healing process has been showed to be facilitated in wounds dressed by amniotic membrane [26]. Branski et al. [27] in their cohort study proved that the amniotic group had a shorter duration of healing compared with other dressing materials. Similarly, the epithelialization rate is faster in partial burn wounds treated with amniotic membrane [28]. Maral et al. [29] have indicated that the amniotic membrane facilitates wound healing at donor sites. Although Atanassov et al. [30] have showed a duration of 15 days for reepithelialization of donor site wounds, such a process in our study lasted as long as 17 days in donor sites dressed with amniotic membrane. The variation may result from differences in thickness and size of the graft, patient's age and health condition, and the anatomical donor site. Our study had unique features, as it selected anatomically similar regions as case and control groups in a single patient to avoid the probable variations among the subjects. In low-income countries, the amniotic membrane could be a cost-effective material for dressing the wounds. In our center, amniotic membranes are obtained from a reserve bank by an air-dried gamma radiation process. Fresh or frozen amnions have not revealed significantly different outcomes for wound healing [31]. Also, the need for reserved frozen amnions is not avoidable in many conditions; besides, by this approach, multiple local burn centers are able to have access to the processed amniotic material to make wide application of amniotic wound dressing possible. In addition to the mentioned benefits of the amniotic dressing in split-thickness skin grafting, this material has showed promising cosmetic results at the wound sites [32].

Our study had several limitations that should be taken into account when interpreting its results; first, we should pay attention to the fact that the procedure of changing wound dressing by nurses was not blinded as both sites that needed to be treated with the routine method and amniotic membrane were in the same individual; however, the patients were blinded to the site of which two different methods of dressing were applied. In addition, we could not use the widely accepted visual analog score scale to measure the level of patient's pain and tolerance in our study, as both the case and control sites were placed in the same subject. Another limitation is the absence of an adequately long duration of follow-up for possible development of hypertrophic scars on donor sites. The comparison of available biological dressings with amniotic membranes would be another perspective that would be of interest in future studies.

Conclusion

Amniotic membrane as an alternative dressing for skin graft donor sites provides significant benefits by increasing patients' comfort through decreasing the pain sensation and improving the process of wound healing.

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