Outcomes of Xenoderm Versus Conventional Dressing in Case of Second Degree Burns

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ABSTRACT

Introduction: For decades burns were treated with different kind of natural and synthetic dressing which had its own advantages and disadvantages. This retrospective study aims to compare the outcomes of xenoderm and conventional dressing in second degree burns.

Material and methods: Sixty patients (24 males, 36 females) with second degree burns with total body surface area of 10% to 50% were investigated from January 2014 to January 2015. They were divided into two groups, first received xenoderm dressing [n=30] and second [n=30] received conventional dressing. The mean age in the xenoderm group and the conventional group was 28 ± 11.6 years and 30.13 ± 10.6 years respectively.

Results: Mean duration of epithelization in xenoderm and conventional group was 12.5 ± 6.9 days and 23.7 ± 14.7 days respectively. Mean duration of hospital stay in xenoderm group is 9.86 ± 6.8 days compared to 16.0 ± 15.3 days in the conventional group. Compared to conventional dressing group, pain duration was shorter, overall average cost and infection rate were lower, total number of dressings were less. There were two deaths occurred in the conventional group, both patients sustained burns of total body surface area of 50%.

Conclusion: Xenoderm dressing is an effective and safe in treating second degree burns. It was observed that xenogenous porcine skin membrane had more beneficial effects in treating burns patients by significant reduction in pain, hospital stay, cost of treatment and infection rates. Thus making it a good choice for treatment in second degree burns alternate to conventional dressings.

Keywords: Burn wound; Xenoderm dressing; conventional dressing; cost

INTRODUCTION

Burn is a partial or complete destruction of the skin usually caused by thermal energy, steam and hot liquids, chemicals electrical or explosions and could be a devastating event which leads to a cascade of life threatening complications.[1] Burns are one of the leading causes of disability and death worldwide, accounting for 300,000 deaths per year.[2,3] These are common entities found in clinical practice and dressings plays a major role in treatment of burns.[1] Widely preferred treatment options include a synthetic (Integra, transyte and biobrane) or biological dressings (xenoderm, xenograft and allografts).[4,5] Wounds that are covered with dressing material heal faster, with less contracture than open wounds. All dressing materials whether biological or non-biological usually acts by forming a barrier between wound and the environment, thereby preventing bacterial infection and wound desiccation.[1-6] However the biological dressing materials show better adherence than non-biological materials and studies have shown that dressing materials, which adhered well to the wound, helped to reduce pain, limit infection and consequently optimize the rate of healing.[7,8]

For achieving better outcomes the wound dressing should possess the desired properties.[9] Xenoderm (porcine skin) has gained a significant acceptance as a temporary dressing for the past 4 decades and several studies reported the efficacy in the treatment of burns.[10-14] Porcine has the advantage which makes it a better dressing material in the treatment of burns which are a) adhering to wound surface, b) proper coverage of nerve endings to decrease pain, c) loss of fluid electrolytes, d) facilitate the proliferation of epithelial cells and e) achieve spontaneous healing.[9,14-16] Availability of porcine skin over xenografts and allografts (homograft and cadaver skin) plays a role for the surgeon to select for transplant purposes. The main advantage of the procine skin is its close nature to human skin, readily available, cost effective and HIV free.[13-15] There is a need for a method in which there is early healing with minimal pain, discomfort and scarring. Thus a need is felt to study the effectiveness of xenoderm dressing in comparison to conventional dressing. In this study (1) we compare the efficacy of xenoderm dressing over conventional dressing in treating cases of second degree burns. (2) To assess infection rates and duration of healing of burns. (3) To compare cost efficacy and duration of hospital stay of patients treated with xenoderm dressing and conventional dressing.

MATERIAL AND METHODS

Between January 2014 to January 2015, 60 patients treated with second degree burns (superficial and superficial plus deep) at 'The First Affiliated Hospital of Soochow University', Suzhou, Jiangsu province, P.R.China were included in the study. An informed consent was obtained from all patients to be enrolled in this study. Institutional review board approval (hospital medical ethics audit No: 2014D245) was obtained for this retrospective case-control study.

The inclusion criterion was: (1) Patients with second degree burns due to flame or scalds less than 48 hours old. (2) Total body surface area (TBSA) more than ≥10% and ≤50%.

The criteria for exclusion was: (1) Wounds or burns with exposed bone, tendon or joint, (2) Electrical and chemical burns, and (3) Burns occurring in children less than 10 years and adults more than 50 years of age.

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Randomly, patients were treated with xenoderm (pig skin) or conventional (silver sulfadiazine (SSD), povidone iodine and paraffin wax). 30 patients underwent xenoderm dressing (M:F 13:17) with mean age of 27.0 ± 16.6 years and 30 patients with mean age of 30.13 ± 10.7 underwent conventional dressing. The male to female ratio was 1:1.5. 38 patients were diagnosed with second degree superficial burns (63.3%) and 22 with second degree superficial plus deep burns (36.7%). Detailed patient demographics were mentioned in table 1, 3.

Technique of application

Xenoderm dressing

Patients were sedated by routine anaesthetic procedure as per department protocol before debridement. A through wash of the burn is done using normal saline. The dead skin and necrotic tissue was removed from the burn wound. Then we used povidone-iodine to wash the wound followed by normal saline, and the procedure was repeated twice. Xenoderm (all xenoderm that were used were manufactured by Yochuang Biomedical technology Co.LTD, Jiangsu, produced under Chinese food and pharmaceutical register number: 2010-36411111, batch number: YZB/China 3037-2010, with a standard size of 20*40, 10*20 cm, from the package slot: DC-ADM-b) was applied to the burn wound with the dermis surface toward the wound by a senior surgeon (Z.X.Y). Later we used cotton gauze to cover the xenoderm and fixed by using bandage. Generally, in the early stage there might be secretions oozing from the wound, these secretions were drained out through the holes on the xenoderm; when the gauze over the xenoderm was soaked wet, we changed the gauze. Because we didn't change the xenoderm on the wound, there were no painful feelings caused, the wound would usually heal in less than two weeks, by this time, the xenoderm is desiccated and peeled off from the newly healed wound by itself. For first degree burn, at our institution, we do not sue xenoderm to cover the wound for dressing. As the first degree burn usually heals in one week without any treatment.

Conventional dressing

After debridement and cleaning, in the early stage (usually for 3 to 5 days) we just used paraffin gauze and ordinary gauze to cover the wound, in the process if the wound is not clean or if there were any signs of wound infection, we then used topical agents such as silver sulfadiazine cream and betadine solution. In order to keep the wound clean and dry, we had to change the dressing every day, or at most every other day, that caused much pain and discomfort to the patients, because of the pain that is caused at the time of dressing change; sometimes we had to sedate the patient. Patients of both the groups were also given intravenous broad spectrum antibiotics and intra muscular analgesics.

Results obtained were calculated according to the following criteria

Rate of healing was measured by the number of days required

Item	Xenoderm Group (n=30)	Conventional Group (n=30)	p
Gender (n)			0.05
Male	13	11	
Female	17	19	
Mean age (x±s years)	27 ± 11.6	30.13 ± 10.6	0.28
TBSA (%)	22.6 ± 13.6	29.1 ± 14.5	0.09
Degree of burn [n (%)]			
2nd degree (superficial)	25 (83.3)	13 (43.3)	
2nd degree (superficial + deep)	5 (16.7)	17 (56.7)	
Cause of burn			
Flames	26 (86.7)	16 (53.3)	
Scald	4 (13.3)	14 (46.7)	
Facial injury [n (%)]	14 (46.7)	17 (56.7)	
Inhalation injury [n (%)]	6 (20)	5 (16.7)	
Co-morbidities [n (%)]			
Diabetes mellitus	15 (50)	18 (60)	0.44
Hypertension	1 (3.3)	0	0.32
TBSA: Total body surface area.			

Table-1: Patients demographics

Item	Xenoderm Group (n=30)	Conventional Group (n=30)	p
Duration of epithelization(x±s days)	12.5 ± 6.9	23.7 ± 14.7	0.0005
Total number of dressings (x±s times)	1.96 ± 2.57	8.73 ± 9.62	0.0007
Duration of pain (x±s days)	6.46 ± 5.74	9.6 ± 8.09	0.04
IV analgesics (x±s times)	7.43 ± 7.25	9.3 ± 8.6	0.36
Infection rate [n (%)]	2 (6.67)	7 (23.4)	0.02
IV antibiotics (x±s times)	7.23 ± 5.59	9.23 ± 8.23	0.27
Debridement (x±s times)	2.03 ± 0.41	1.9 ± 0.54	0.29
Death [n (%)]	0	2 (6.66)	0.005
Duration of hospital stay (x±s days)	9.86 ± 6.8	16.0 ± 15.3	0.04
Cost of treatment, ¥ (x±s)	14693 ± 8739.14	26220 ± 2387.32	0.001
IV: Intravenous			

Table-2: Outcomes of treatment in both groups

Item	Xenoderm Group (n=30)	Conventional Group (n=30)
Age		
<15	4	2
15-30	15	12
30-50	11	16
TBSA (%)		
<20	15	
20-40	9	13
>40	6	9
TBSA: Total body surface area.		

Table-3: Grouping by age, and TBSA in both groups

for complete epithelialization of the wound.

Total no of dressings done were recorded during the hospital stay.

Infection as being present or absent by checking for any pus under the dressing visually, and when infection is present, the puss is sent for culture and sensitivity.

Patient compliance is determined by the feedback given by the patients about the comfortability of the dressing during follow-up.

Duration of hospital stay and cost of hospital stay are obtained from the hospital medical records.

STATISTICAL ANALYSIS

All statistical analysis were performed by SAS for windows version 8.2 (SAS Inc, USA). Values and measurement data were expressed by mean ± standard deviation, frequency and percentage. The continuous data were analysed by two tailed, unpaired student 't' test. When the data couldn't meet normal distribution, Mann-Whitney U test was selected. Statistically significant difference in frequencies was evaluated by Chi-square analysis. A p value of <0.05 was considered to be statistically significant.

RESULTS

Age: In this study patients within the age group of 10 to 60 were included with most of them belonging to less than 25 years of age. No statistical significance was observed for age compared between the groups p=0.05 (Table 1, 3).

Sex: Of the 60 cases included in this study, 36 patients were females and 24 patients were males. There is a female preponderance of cases in the present study with a male to female ratio of 1:1.5 (Table-1).

Duration of epithelisation: In the study groups epithelization is observed faster in cases treated with xenoderm dressing than in patients treated with conventional dressing. Facial burns treated with xenoderm dressing had better healing with less scaring and less contractures. Mean duration of epithelization in xenoderm and conventional group of dressing is 12.5 and 23.7 respectively. This is statistically significant with a p=0.005 (Table-2).

Total number of dressings: Patients treated with xenoderm required dressing only once compared to multiple dressing in case of conventional modes of dressings. There is a better compliance for single dressing compared to multiple dressing in conventional dressing. It's advantageous in decreasing the pain to the patient and reducing burden on medical personal. It is statistically significant with a p=0.0007 (Table-2).

Duration of pain: Patients treated with xenoderm dressings have significant decrease in pain within 24 hrs of dressing with a decreased need for IV/IM analgesics. Mean pain scoring in xenoderm group is 6.4 days compared to 9.6 days in conventional groups with statistical significance with a p=0.04. even though there was a significant decrease in the pain levels in the xenoderm treated patients, but the need for IV analgesics was not statistically significant p=0.36 (Table-2).

Infection rates: Due to early epithelization and less exposure of raw surface, the infection rate in xenoderm group is less than conventional group. Infection rate is assessed by looking for any pus under the dressing. 2 of 30 patients in xenoderm group and 7 of 30 patients in conventional group had wound infection with a p=0.02 (Table-2). The most common organism of infection in both the groups was Pseudomonas. Other common organisms were Klebsiella, Streptococcus etc. Most of the infective organisms are more sensitive to cephalosporin's and beta-lactam antibiotics. However there was no statistical difference observed in the use of antibiotic infusion in both groups p=0.27. There were two deaths recorded in the conventional group, both patients sustained burns of TBSA 50%. No deaths were recorded in the xenoderm group (Table-2).

Duration of hospital stay: Patients treated with xenoderm dressing discharged early compared to the patients treated with conventional dressings. Patients are discharged after at least 50% of epithelization. Mortality occurred in two patients treated with conventional modes of dressings with 45% and 50% burns. Mean duration of hospital stay in xenoderm group is 9.86 days where in case of conventional dressing it was 16.0 days. Significant statistical difference was observed p=0.04 (Table-2).

Cost of the treatment: Cost of the treatment is significantly low in patients treated with xenoderm dressing and was more in conventional dressings. Operation room cost and dressing costs have also been included to determine the signifance of cost of treatment. For the xenoderm group the average cost was RMB 14693± 8739.14 (range, 6200~34560 RMB), and in the conventional group the cost averaged RMB 26220 ± 2387.32 (range, 9000~45000 RMB), with a significant statistical difference between the groups p=0.0001. For the xenoderm group the total average cost is 50% less compared to conventional dressing group (Table-2).

DISCUSSION

Treating patients who suffered with burns is a challenging task to surgeons. Extensive involvement of body surface area by burn is a painful condition and is highly susceptible to infection increasing the morbidity and mortality.[4] Raw areas of skin cannot prevent the loss of body heat as the normal skin does by controlling vasodilation and sweat formation.[17] Biological dressing (xenoderm) possess numerous properties which promotes wound healing, porcine dressing is one of its kind. It protect the wound from loss of fluid, protein and loss of heat, and it is considered a better choice of dressing which provides pain relief relatively faster when compared to other conventional dressing materials.[7,13,18,19] Both xenoderm and conventional dressings poses significant advantages therefore the purpose of this study was to analyse the outcomes and

evaluate the potential benefits, we hypothesize that xenoderm outweigh the potential benefits of conventional dressings.

Surprisingly there were very limited literatures on porcine skin and its derivatives on burn care although it is being used for a very long time since the early 1960's.[11] In addition, the result previously published had mixed conclusions.

Wound infection is a serious problem sustaining a burn injury, this is the leading cause of sepsis could even lead to death of the patient.[5,20,21] A study by de Macedo et al[21] on 252 patients treated at the burns unit, 19.4% developed clinically and microbiologically proven sepsis. Several factors have been identified for burn infections, most important are the extent of burn, age of the patient, comorbidities, impairment of blood flow and microbial factors.[22] Our results showed that in the conventional group the rate of wound infection was higher compared to that of the xenoderm group (6.6% Vs. 23.3%). Though literatures reported low infection rates using conventional dressing[23,24], in a clinical trial of 78 patients by Hosseini et al[12], reported significant higher wound infection rate between sliver sulfadiazine (SSD) and xenoderm (40.5% Vs. 17.9%). Similar results were reported by Caruso D.M et al[25] and Costagliola M et al.[26] One possible explanation for the increased wound infection in the SSD treated patients is the repated change of dressings leading to contaminations. The adherence characteristic of xenoderm prevents the formation of hematoma and seroma, thereby acting as a physical barrier against nosocomial cultures.[10,27,28]

The role of silver and sulfadiazine in the mechanism of action of silver sulfadiazine on burn wound infections was extensively investigated. Bacteria was bound by the silver but not sulfadiazine. Low concentrations of sulfadiazine did not act as an antibacterial agent, but showed joint action in combination with sub-inhibitory levels of silver sulfadiazine. Silver sulfadiazine's efficacy results from its slow and steady reaction with serum and body fluids contacting sodium chloride. Therefore permitting slow and sustained delivery of the silver ions in to the wound.[29]

Reduction in number of dressing post application of xenoderm plays a major role in pain relief at the time of dressing replacement, patients comfort and significant reduction of overall cost. Hosseini et al[6], reported that the mean number of dressings after xenograft was 1.51 ± 1.6 (range 1~9). The same study reported that 86% of patients had only one dressing change post-surgery. In comparison, in our study we found a significant statistical difference in the number of dressings in both groups (p=0.0007). Our results were supported with similar literatures.[8] Dressing was required only once in case of xenoderm group and multiple dressings were required in the conventional groups causing pain to the patient during every day dressing and a significant burden to the attending medical staff.

In the present study duration of epithelization (days) was significantly lower compared between xenoderm and conventional groups (p=0.0005). Re-epithelialization is the integral stage in the repair of superficial and deep atrial thickness burns to restore the full function of dermis, during which keratinocytes migrate and proliferate to cover epidermal defects. Xenoderm is found to have a positive role on the proliferation and differentiation of human keratinocytes as well on fibroblast proliferation.

Use of porcine dressing has also been associated with decrease in duration of hospital stay and overall cost. In a study by Still et al[30], reported an average duration of hospital stay of 7 days with 19.3% needing readmission for subsequent excision and grafting in patients with 25% TBSA. They found that application of porcine xenograft resulted in overall decreased duration of hospital stay even when accounting for these additional procedures.[30] In our study, the average duration of hospital stay in the xenoderm group was 9.86 days which was statistically significant (p=0.04).

Xenoderm is readily available mainly from commercial pharmaceutical companies and its supply is adequate and well controlled. There are well established quality control for the production and usually companies are well stocked thus making less expensive compared to other available biological dressings. To our knowledge, so far no published studies reported the cost effectiveness of xenoderm dressings, despite the abundant availability and its wide usage. In a review by Hermans et al[4], mentioned the cost of a single porcine xenograft sized 8*10 cm was $25 ((¥150)for gluteraldehyde preserved and $0.15-$0.71 (¥0.9 - ¥4.27) for cryopreserved xenograft, which was far cheaper than the available biological dressing products. At our institution all the xenoderm that we used were gluteraldehyde preserved and were manufactured by Yochuang Biomedical technology Co-LTD. In our study the overall average cost for xenoderm and conventional group was ¥14693± 8739.14 and ¥26220 ± 2387.32 respectively. Our results shows that xenoderm dressing was approximately 50% cheaper compared to conventional dressing.

This study has several limitations, which includes: (1) being a retrospective study, this would have compromised the analysis; (2) the sample size is relatively small to draw any conclusions, and there was no control group, which could reduce the objectivity of the study. In order to draw a conclusion, a relatively large sample is required; this might lead to underestimate the significance of the outcomes. Further prospective randomized studies should be undertaken to determine the advantages and draw solid conclusions in treating burns with xenoderm.

In the present study xenoderm is used as an alternative to SSD to cover the raw areas during the initial phase of healing in 30 out of the 60 patients included in the study. Duration of epithelization is early in case of xenoderm group patients compared to conventional group patients.

CONCLUSION

Xenoderm dressing is an effective and safe in the treatment of second degree burns. Xenoderm dressing was found to facilitate the rapid formation of granulation tissue, forms a barrier prevents excess fluid loss, and prevents infection. It was observed that xenogenous porcine skin membrane had more beneficial effects in treating burn patients by significant reduction in pain, hospital stay, cost of treatment and infection rates. Its wide availability and less cost, make it a good choice for treatment of second degree burns alternate to conventional dressings.

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