

Comparison of open and closed burn wound dressing applications with tissue culture sampling

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ABSTRACT

BACKGROUND: Secondary infections are the leading cause of death in burn patients. The purpose of this study is to evaluate the effects of open and closed burn dressings on the development of secondary infections.

METHODS: Tissue cultures were obtained from the burn sites of 56 patients between the ages of 18 and 65 who were admitted to our burn unit between December 2022 and January 2023, on days 3 and 7. The impact of the demographic features of the patients, the characteristics of the burn wound, the dressing type, and the first intervention strategies given to the burn wound on the development of wound infection were evaluated.

RESULTS: There was no statistically significant difference between the open- and closed-dressing groups in terms of cultural positivity ($P>0.05$). A statistically significant difference ($P=0.019$) was found between the groups in terms of culture positivity among those whose wounds were cleansed with warm water as the initial intervention after a burn and those whose wounds were not.

CONCLUSION: Even though the main impacts of the patient's variables on the development of a wound infection are recognized, it has been found that the appropriate and successful first intervention in a burn wound is also quite important.

Keywords: Burn; dressing; wound infection.

INTRODUCTION

Patients with burns are a high-risk patient population because of the high rates of mortality and morbidity found during and after care. They often need psychological and social assistance during the therapy procedure.^[1] Seventy-five percent of burn-related fatalities are due to secondary infections, making them the primary cause of death to burn patients.^[2] According to the burn center, wound infections, sepsis, hospital-acquired pneumonia, and urinary tract infections are common among burn patients.^[3]

In recent years, the mortality rates of burn patients have reduced dramatically owing to the proliferation of specialized burn centers and burn specialists, as well as developments in

contemporary medical treatment. It has been related to medical advancements in fluid resuscitation, nutritional support, respiratory care, burn wound care, and infection control techniques. Therefore, as a consequence of medical advancements and expertise in burn treatment, in the last 40 years, the severity of burns has resulted in a 50% decline in deaths.^[4]

Damaged areas, whose tissue integrity is compromised by burns, cannot block the passage of microbes, and necrotic tissues following burns provide a favorable habitat for microorganism proliferation. Due to the deleterious effects of burns on the immune system, burn patients are also more susceptible to endogenous and external infections, and the rates of secondary infections rise.^[5]

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Given that degradation of skin integrity is one of the leading causes of infection in patients with burns of the second degree or more severe, all dressing applications should be closed. Some facilities follow patients with open dressings, despite the fact that closed dressings are chosen by the majority. No investigation on infection rates for various dressing applications has been discovered in the published literature. The purpose of this research is to compare the impact of open and closed burn dressings on the onset of secondary infection.

MATERIALS AND METHODS

Fifty-six patients who applied to our hospital's burn unit outpatient clinic between December 2022 and January 2023 were included in this research. Inclusion criteria in our research were those aged between 18 and 65, those with second-degree and severe burn wounds, those who were first applied to our unit, and those who were treated in external centers and had a burn duration of <5 days. Those who went to another burn center after beginning their therapy or who discontinued the treatment willingly were not included in the research.

Our burn unit routinely obtains tissue cultures from burn sites after admission. However, empirical antibiotherapy is not administered to patients who lack growth positivity in tissue culture and who lack evidence of local and systemic infection. After the wound site was washed with saline in accordance with asepsis and antisepsis guidelines, a superficial scrape was performed with a scalpel to collect the tissue culture. On the day of admission (day 0) and the 3rd day, tissue cultures were taken from individuals who applied to our clinic and matched our inclusion criteria. The patient who showed growth in either of the 0th or 3rd day tissue cultures underwent a 7th day tissue culture. The patients' age, gender, body mass index (BMI), educational status, chronic conditions, medications, kind and severity of burns, and dressing types (closed and open) were recorded. Closed dressing is the process of closing a wound with a sponge, bandage, and net after removing dead tissue and providing medication. After medication administration, an open dressing involves the removal of dead tissue and leaving the incision fully exposed. The study's data were analyzed using SPSS 23.0 (Statistical Package for the Social Sciences). Before the data were evaluated, descriptive statistics were compiled. For continuous and discrete numerical data, descriptive statistics are reported as mean \pm standard deviation, and for categorical variables, as number and percentage distribution. Using chi-square testing, categorical variables were examined $P < 0.05$ was indicated as statistical significance.

The Ankara Training and Research Hospital approved our study of the Medicine Hospital Ethics Committee (Decision Number: E-22-1152).

RESULTS

The distribution of patients according to various descriptive

criteria is presented. The research comprised 56 individuals with an average age of 42.6 ± 17.7 years. There were 21 (37.5%) male patients and 35 (62.5%) female patients. When their educational level was assessed, it was discovered that 8.9% were illiterate, 23.2% had completed primary school, 23.2% had completed secondary school, 32.1% had completed high school, and 12.5% had completed university. There were 42 patients (75.0%) who did not have any chronic conditions and 29 (51.8%) who did not smoke. When the patients' BMIs were calculated, it was discovered that 22 (39.3%) had a normal BMI, 15 (26.8%) were overweight, and 19 (33.9%) were obese. 37 patients (66.1%) were classified as ASA 1, 11 (19.6%) as ASA 2, and 8 (14.3%) as ASA 3 (Table 1).

When the burn cases of our patients were analyzed, it was discovered that the most frequent form of burn was scalding with hot liquid (78.6%), and the most common type of burn was a second-degree deep burn (87.5%). When considering the patients' initial interventions to their own wounds at the time of the burn, it was shown that washing with warm

Table 1. Some descriptive characteristics of the patients (n=56)

Descriptive characteristics	n (%**)
Age (year), mean \pm SD	42.6 \pm 17.7
Gender	
Male	21 (37.5)
Female	35 (62.5)
State of education	
Nonliterate	5 (8.9)
Elementary school	13 (23.2)
Secondary school	13 (23.2)
High school	18 (32.1)
University	7 (12.5)
Chronical health disorder	
Absent	42 (75.0)
Exist	14 (25.0)
Smoking habit	
Nonsmoker	29 (51.8)
Smoker	27 (48.2)
BMI (kg/m ²)	
Normal (18.5–24.9)	22 (39.3)
Over-weighted (25–29.9)	15 (26.8)
Obese (\geq 30)	19 (33.9)
ASA	
ASA 1	37 (66.1)
ASA 2	11 (19.6)
ASA 3	8 (14.3)

**Percentage column. SD: Standard deviation; BMI: Body mass index; ASA: American Society of Anesthesiologists

Table 2. Characteristics of the burns of patients

Characteristics	n (%)*
Burn type (n)	
Scald	44 (78.6)
Touch	5 (8.9)
Flame	4 (7.1)
Chemical	1 (1.8)
Ice l	(1.8)
Vapour	1 (1.8)
Burn severity (n)	
2. degree superficial	3 (5.4)
2. degree deep	49 (87.5)
3. degree	4 (7.1)
First intervention (n)	
No intervention	6 (10.7)
Ointment	8 (14.3)
Washing with warm water	42 (75.0)
Admit time (n)	
08:00–16:00	47 (83.9)
16:00–08:00	9 (16.1)
Wound dressing type (n)	
Closed	30 (53.6)
Open	26 (46.4)
Antibiotic treatment (n)	
Absent	39 (69.6)
Receive	17 (30.4)

*Percentage column

Table 3. Microorganisms reproducing in patients and number of patients

Microorganism	Day 0	Day 3	Day 7
Staphylococcus aureus	3	4	2
Staphylococcus epidermidis	1	2	-
Staphylococcus haemolyticus	1	-	1
Staphylococcus warneri	1	-	-
Streptococcus	-	1	-
Acinetobacter johnsonii	1	1	-
Acinetobacter pittii	1	1	-
Enterobacter	1	1	-
MRSA+	1	-	-
No growth	46	46	13
No culture obtained	-	-	40
Total	56	56	56

MRSA: Methicillin-resistant Staphylococcus aureus

compared based on the first intervention approaches used on burn patients. The incidence was established to be 66.7% for those who did not get any intervention, 50% for those who applied ointment, and 19.0% for those who washed with warm water. There was a statistically significant difference ($P=0.019$) between the types of first burn wound treatments and the microorganism growth rates in tissue cultures.

In terms of microorganism development in tissue cultures obtained from burn wounds, there was no statistically significant difference between patients with or without chronic illness, smoking status, BMI, dressing style (open or closed), and antibiotic therapy ($P>0.05$) (Table 4).

DISCUSSION

An important cause of mortality and morbidity in hospitalized burn patients is infection. Loss of the skin's barrier function may result in systemic sepsis, shock, and mortality in burn patients. The likelihood that a local infection may spread to the rest of the body may rise with age, the size and severity of the burn, and the immunosuppression caused by other comorbid conditions, particularly diabetes. Due to the loss of the skin, the body's primary defensive system, it is easier for pathogens to penetrate the wound and infiltrate the bloodstream.^[6]

Diagnosing wound infection in burn patients may be occasionally difficult. Symptoms such as pain, fever, and tachycardia are typically seen at the burn site as a consequence of the cytokine and immune system responses that occur after a burn.^[7] In addition, not all erythematous wounds should be considered infectious. Because there are similarities between the skin changes caused by an infection and those caused by a burn. Erythema, elevated local temperature, edema, and discomfort are quite prevalent symptoms. To differentiate between these two conditions, both subjective and objective

water (75.0%) was the most prevalent, followed by applying ointment to the burn region (14.3%). However, it was shown that six patients did not intervene in the burn area. During regular business hours, 83.9% of patients applied to the hospital (08:00–16:00). 30 (53.6%) patients had closed dressings, whereas 26 (46.4%) received open dressings. We did not commence antibiotic therapy in any patient at the initial intervention, and 30.4% of patients arrived at our clinic having antibiotic treatment begun by other clinics (Table 2).

While growth was detected in 10 of the wound tissue cultures obtained from all of the patients ($n=56$) during the first treatment, regrowth was discovered in the cultures of 4 patients who had growth during the initial application. In addition, six individuals who did not develop on the 1st day showed growth on the 3rd day. There was growth in the cultures obtained from 16 patients on the 7th day, for a total of 3 individuals. Staphylococcus aureus was identified as the most prevalent causal agent in cultures showing growth at admission, day 3, and day 7 (Table 3).

The growth rates of microorganisms in wound cultures were

Table 4. Comparison of microorganism growth in wound culture according to some characteristics of patients (n=56)

Characteristics	Negative culture, n (%)*	Positive culture, n (%)*	P** -value
Chronical disorder			
No	31 (73.8)	11 (26.2)	0.511
Yes	9 (64.3)	5 (35.7)	
Smoking habit			
Nonsmoker	19 (65.5)	10 (34.5)	0.472
Smoker	21 (77.8)	6 (22.2)	
BMI (kg/m ²)			
Normal (18.5–24.9)	16 (72.7)	6 (27.3)	0.890
Over weighted (25–29.9)	10 (66.7)	5 (33.3)	
Obese (≥30)	14 (73.7)	5 (26.3)	
Wound dressing type			
Close	21 (70.0)	9 (30.0)	1.000
Open	19 (73.1)	7 (26.9)	
First intervention			
No intervention	2 (33.3)	4 (66.7)	0.019
Ointment	4 (50.0)	4 (50.0)	
Washing with warm water	34 (81.0)	8 (19.0)	
Antibiotic treatment			
Absent	29 (74.4)	10 (25.6)	0.527
Receive	11 (64.7)	6 (35.3)	

*Chi-square test. BMI: Body mass index

wound findings must be considered. Subjective findings include pain, erythema, odor, changes in wound color or depth, eschar dehiscence, and systemic infection indicators. Wound culture results obtained from swabs or tissue biopsies are objective findings.^[8] After examining the patient as a whole, the practitioner should identify the problem as a wound infection or burn-related disorder.

Due to the frequency and severity of nosocomial infections in burn patients, systemic antibiotic prophylaxis is often necessary in addition to conventional infection prevention and control measures. However, it has been argued that the use of prophylactic antibiotics causes more harm than benefit, including drug toxicity and the development of multidrug resistance, and its efficacy is still the subject of debate.^[4,9] Therefore, many burn therapy regimens exclude systemic antibacterial prophylaxis.^[10,11] Our therapeutic strategy is not to provide prophylactic antibiotics to patients. However, the prophylactic antibiotic therapy begun by other centers before applying to ours was maintained for 10 days. If the antibiotic employed according to the culture antibiogram result is not sensitive to the agents produced in the culture, it is changed with a sensitive antibiotic and administered for 10 days in the event of tissue culture growth. In order to avoid antibiotic resistance, antibiotic therapy is not terminated after the first application.

As a result of the epidermis and dermis layer damage, the burn site is exposed and susceptible to external influences. Follow-up care for burn wounds may include the use of both open and closed dressings. According to conventional wisdom, a burn wound should be kept uncovered so that it may dry out and heal more quickly. However, most patients who have therapy with this procedure get a hypertrophic scar or keloid. Using successive dressings, the wound should be debrided of dead tissues, fibrin, and eschar. Granulation and epithelialization of clean, viable scar tissue acquired following debridement are thought to be necessary for a good recovery. After dressing and debridement, local treatment (ointment, pomade, paraffin-impregnated gauze, etc.) was administered to all of our patients. A mesh bandage was applied to the burn site, which was coated with wet gauze and wrapped in linen. During the application of this closed dressing method, the burn area was soaked with distilled water with decreasing frequency until the next dressing application, and the wound was kept moist.

In the tissue management, infection control, moisture balance, and edge advancement (TIME) framework approach, foreign and dead tissues are removed, infection is brought under control, and the wound bed is restored to its optimal condition.^[12-15] During the healing process within the TIME framework, the various roof components are spirally inter-

connected. Multiple elements of the roof might be affected by a single intervention; for instance, a debridement will remove necrotic tissue and prevent bacterial colonization.^[13,16,17]

It was found that 75% of burn patients used water as their initial treatment. In awareness research, 54.7% of individuals emphasized the need to wash burned areas with water.^[18] This finding indicates that our patients were more aware of the primary treatment intervention for burns. In addition, when the growth in the cultures of the patients was analyzed in terms of the first intervention to the burn wound, it was shown that the patients whose burn wounds were treated with water had significantly less growth. In research done in Australia, it was shown that prompt and appropriate treatment of burn wounds minimizes the chance of wound worsening, hospitalization, and the need for surgical operations.^[19] In an examination of patients whose burns were treated with warm water flowing for 20 min during the first 3 h, it was determined that the depth of the burn was smaller, re-epithelialization occurred more quickly, and there was less need for grafting, debridement, and surgical operations.^[20] When all of these parameters are considered, it is clear that the initial intervention for a burn wound is directly connected to wound infection and wound healing, and the literature supports our findings.

In this study, regular wound tissue cultures were evaluated to objectively compare the impact of closed and open dressing procedures used during the treatment of burn wounds on the development of secondary wound infection. In all groups, tissue care with moisture balance and debridement, considering other components of the TIME framework, resulted in successful wound healing. In terms of tissue culture findings, no statistically significant differences were identified between the groups. The limited sample size is a limitation of our study, and we believe that the closed dressing technique combined with the TIME framework approach will have a predictive effect on burn wound healing in a broader case series.

Conclusion

Considering the effect of an open or closed dressing approach on wound infection in burns, we believe that the variables connected to the wound and the appropriate and efficient first intervention at the burn site are more essential than the factors that cannot be changed.

Ethics Committee Approval: This study was approved by the Ankara Training and Research Hospital Clinical Research Ethics Committee (Date: 28.12.2022, Decision No: E-93471371-514.99)

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ORİJİNAL ÇALIŞMA - ÖZ

Doku kültürü örneklemesiyle açık ve kapalı yanık yara pansuman uygulamalarının karşılaştırılması

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AMAÇ: Yanık hastalarında mortalitenin sebeplerinin başında sekonder enfeksiyonlar yer almaktadır. Bu çalışmanın amacı, açık ve kapalı yanık yara pansuman uygulamalarının sekonder enfeksiyon gelişimi üzerindeki etkilerini değerlendirmektir.

GEREÇ VE YÖNTEM: Aralık 2022 ve Ocak 2023 tarihleri arasında yanık ünitesine başvuran yaşları 18-65 arasında olan 56 hastanın yanık yarasından başvuru anında, 3. ve 7. günlerde doku kültürleri alındı. Hastaların demografik özellikleri, yanık yarasının özellikleri, pansuman tipi ve yanık yarasına yapılan ilk müdahale yöntemleri incelenerek yara yeri enfeksiyonu gelişimindeki etkileri değerlendirildi.

BULGULAR: Açık ve kapalı pansuman yapılan hasta gruplarından alınan yanık yara kültürleri değerlendirildiğinde kültür pozitifliği açısından gruplar arasında anlamlı bir fark bulunmadı ($p>0.05$). Yanık sonrasında yapılan ilk müdahale olarak yara yeri ılık su ile yıkananlarda kültür pozitifliği diğer gruplardan daha düşük bulundu, gruplar arasında istatistiksel olarak anlamlı fark saptandı ($p=0.019$).

TARTIŞMA: Klasik bilgilerimize göre yara yeri enfeksiyonu gelişimi açısından hastaya ait faktörlerin dominant etkileri bilinmesine rağmen, yanık yarasında doğru ve etkin yapılan ilk müdahalenin de oldukça önemli olduğu görülmüştür.

Anahtar sözcükler: Pansuman, yanık, yara yeri enfeksiyonu.

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