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Patterns of skin substitute use in isolated face and hand burns

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ABSTRACT

Non-medical factors may influence a wide variety of medical care. This study uses a large national database to examine potential factors influencing the use of skin substitutes in patients with face and hand burns. A total of 2847 patients with isolated 3rd degree hand and face burns from the NBR were identified from the NBR. Of those 2847 patients, 2299 (81%) had autografting alone. 143 patients (5%) had heterografting followed by autografting, 318 (11%) had homografting followed by autografting, and 87 patients (3%) had a dermal regenerative graft followed by autografting. Findings indicated that race and insurance status may influence the use of skin substitutes in isolated face and hand burns. Dermal regenerative grafts are more likely to be used in white patients with commercial insurance ($p < 0.001$), whereas homografting is more likely to be used in non-white patients with commercial insurance ($P < 0.001$). Potential factors contributing to these findings are not all available in this large national database, but awareness of these trends is important when deciding on an operative plan in patients with face and hand burns.

1. Introduction

Society places great emphasis on physical attractiveness, with both men and women rating good looks as an important factor when seeking a potential mate [1]. The most important anatomic areas for perceived attractiveness are the face [2] and hands [3]. Because of this, additional care is taken with burn patients to ensure the optimal aesthetic outcome when grafting the face and hands. This entails sheet grafting in most cases, but many centers are also using staged procedures with skin substitutes followed by autografting to further improve aesthetic outcomes. Although there are thought to be some cosmetic advantages to these skin substitutes, they are often expensive and that expense may play a role in their use in burn patients. Previous work has shown that non-medical factors influence the use of these skin substitutes in patients with larger total-body surface area (TBSA) burns [4]. In this study, we wanted to determine whether some of those same factors influenced the choice of skin substitute type in burn patients with smaller isolated face and/or hand burns.

2. Methods

The National Burn Repository (NBR) is a national database of burn patients supported by the American Burn Association (ABA). We used NBR version 8.0, which encompassed data on patients from 2002 to 2011. This is the most recent complete version of the NBR. We limited our search to patients with burn mechanism of injury of flame, scald, chemical, and electrical. Inclusion criteria were 3rd degree burns limited to the face, neck, or hands. Graft types used were identified by ICD-9 procedure codes (85.82, 85.83, 86.0, 86.1, 86.2, 86.3, 86.63, 86.69, 86.65, 86.66, and 86.67). The database only includes data from the primary admission. Demographic variables recorded included age, gender, race, and payer status. Commercial insurance included private commercial insurance as well as worker's compensation. Non-commercial insurance included Medicare/Medicaid, self-pay, or no insurance. Other patient characteristics assessed included burn size (TBSA), presence of inhalation injury, treatment facility, hospital days, ICU days, hospital charges, and mortality.

The total cohort was then divided into four groups: autograft alone, heterograft with autograft, homograft with autograft, and dermal regenerative graft with autograft. These groups were compared across all variables using ANOVA for continuous variables and Chi2 analysis for categorical variables. Then, these patients were broken down into another sub-analysis using four groups: whites with commercial insurance, whites with non-commercial insurance, non-whites with commercial insurance, and non-whites with non-commercial insurance. These groups were analyzed using Welch's ANOVA for unequal variances in continuous variables and Chi2 for categorical variables. Finally, multinomial logistic regression analysis was performed to find relative risk ratios (RRR) predicting grafting type for each variable. All analyses were conducted using STATA 14.2 (StataCorp College Station, TX).

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Institutional review board approval was not required as only deidentified data was analyzed.

3. Results

A total of 2847 patients were identified, patient characteristics and outcomes are shown in Table 1. Of those 2847 patients, 2299 (81%) had autografting alone. 143 patients (5%) had heterografting followed by autografting, 318 (11%) had homografting followed by autografting, and 87 patients (3%) had a dermal regenerative graft followed by autografting. 67.7% of all patients were male, as expected in the burn population, and that gender distribution was similar among all the grafting groups ($p = 0.831$). All patients getting a skin substitute had larger burns than graft alone, but the actual clinical difference was small enough to be a non-factor in choosing type of graft (less than 3.6% TBSA average difference for any skin substitute). Likewise, patients with skin substitutes were more likely to have inhalation injury ($p = 0.032$). White patients were significantly more likely to get a dermal regenerative graft (71.8% white patients) compared to autografting alone (58.3% white patients, $p = 0.04$). Patients with commercial insurance were more likely to get a dermal regenerative graft or homograft than autografting alone, and patients with commercial insurance were less likely to get heterograft than autografting alone ($p = 0.022$).

As expected with staged surgeries, hospital stay was longer for patients with skin substitutes versus autografting alone ($p < 0.001$). ICU and ventilator days were also higher in the skin substitute group ($p < 0.001$), likely correlating with the higher incidence of inhalation injury. As expected with longer hospital stays, patients with skin substitutes had higher hospital charges ($p < 0.001$), though it was somewhat surprising to see that dermal regenerative grafts resulted in lower hospital charges than heterograft or homograft. Mortality was low in all groups and did not differ significantly ($p = 0.319$).

Because race and insurance status both predicted type of skin substitute used, we broke these patients down into further subgroups of whites with commercial insurance, whites with non-commercial insurance, non-whites with commercial insurance, and non-whites with non-commercial insurance (Table 2). Whites with commercial insurance were more likely to receive a dermal regenerative graft than other subgroups (5.5%, $p < 0.001$). Whites with non-commercial insurance had a higher rate of homografting than the other subgroups (15.6%, $p < 0.001$). Non-whites with commercial insurance were more likely to receive a heterograft (6.8%, $p < 0.001$), and non-whites with non-commercial insurance had a higher rate of autografting alone (83%, $p < 0.001$).

Then, multinomial logistic regression analysis was performed to find predictors of grafting type for each variable (Table 3). For those patients having heterografting followed by autografting, only burn size was a significant predictor (RRR = 1.08, $p < 0.001$), though non-whites with commercial insurance trended toward significant predictive value (RRR = 2.03, $p = 0.072$) compared to whites with commercial insurance. In the homografting plus autografting group, age was a predictor of receiving homograft (RRR = 1.01, $p = 0.020$), as was burn size (RRR = 1.05, $p < 0.001$). Non-whites with commercial insurance were more likely to get homografting compared to whites with commercial insurance (RRR = 1.70, $p = 0.010$), and non-whites with non-commercial insurance were less likely to get homografting, though this did not quite reach statistical significance (RRR = 0.48, $p = 0.055$). For dermal regenerative grafting, the strongest predictor was being white with commercial insurance. All other subgroups were less likely get a dermal regenerative graft.

4. Discussion

Health care disparities have been documented in a number of medical specialties. Hsu et al. found that in women with ectopic pregnancy, women with Medicaid or no insurance were less likely to get methotrexate than women with commercial insurance. In addition, women with ectopic pregnancies that required surgery were less likely to have tubal conserving surgery if they were Black or Hispanic [5]. In patients with peripheral vascular disease, Hispanic and African-American patients are more likely to have amputations compared to White patients [6]. Wound coverage in small isolated face and/or hand burns can be accomplished in a number of ways. However, cosmetic concerns may be more important in these anatomic areas [2,3], and some skin substitutes are theorized to improve cosmetic and functional results [7]. Our goal was to study whether non-medical factors affected the choice of skin substitutes in patients with isolated face and/or hand burns.

In this study, there were several interesting findings. First, the use of skin substitutes for isolated face and hand burns did differ significantly by race. Most notably, white patients were more likely to get a dermal regenerative graft than non-white patients. This was noted on both univariate and multivariate analysis. Because supporters of the use of dermal regenerative grafts claim that decreased hypertrophic scar (HTS) is a potential benefit of these products [7], one would surmise that they would be used in groups at high risk for HTS. However, it has been shown that non-whites are at higher risk of HTS [8] and thus should benefit more from the use of dermal regenerative grafts. It could be a potential con-

Table 1
Patient Characteristics.

	Patient Cohort ($N = 2847$)	Autograft ($N = 2299$)	Heterograft ($N = 143$)	Homograft ($N = 318$)	Dermal Regenerative Graft ($N = 87$)	P value
Age years, mean (SD)	31.5 (22.1)	30.6 (21.9)	37.2 (19.0)	36.2 (19.0)	33.3 (22.8)	<0.001
Gender male, N (%)	1920 (67.7)	1550 (67.6)	96 (67.6)	218 (69.4)	56 (64.4)	0.831
Race white, N (%)	1578 (58.4)	1271 (58.3)	84 (60.4)	162 (54.6)	61 (71.8)	0.04
Payer commercial insurance, N (%)	1252 (50.1)	977 (49.0)	62 (46.6)	164 (56.4)	49 (60.5)	0.022
Inhalation injury, N (%)	124 (5.5)	92 (4.9)	7 (7.1)	18 (7.5)	7 (12.3)	0.032
Burn size, mean (SD)	4.6 (6.8)	4.1 (5.9)	7.7 (9.2)	6.6 (10.1)	6.2 (7.7)	<0.001
Head 3rd degree%, mean (SD)	0.5 (1.4)	0.4 (1.1)	0.9 (1.9)	1.3 (2.0)	0.6 (1.4)	<0.001
Neck 3rd degree%, mean (SD)	0.1 (0.3)	0.1 (0.3)	0.2 (0.4)	0.1 (0.4)	0.1 (0.3)	<0.001
Hands 3rd degree%, mean (SD)	1.4 (1.2)	1.3 (1.1)	1.6 (1.3)	1.7 (1.4)	1.5 (1.4)	<0.001
Hospital days, mean (SD)	10.6 (13.1)	8.7 (10.3)	16.7 (10.3)	19.9 (17.1)	15.0 (20.4)	<0001
ICU days, mean (SD)	4.1 (10.0)	3.2 (7.6)	7.5 (14.6)	8.0 (14.6)	7.4 (15.6)	<0.001
Vent days, mean (SD)	1.4 (6.3))	1.1 (5.1)	1.9 (8.0)	3.5 (10.1)	2.9 (10.4)	<0.001
Hospital Charges (thousands), mean (SD)	88.5 (14.1)	64.8 (98.9)	100.8 (149.0)	179.8 (226.5)	148.2 (126.3)	<0.001
Outcome alive, N (%)	2822 (99.1)	2279 (99.1)	143 (100)	313 (98.4)	87 (100)	0.319

Abbreviations: ICU, intensive care unit; SD, standard deviation.

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