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Self-inflicted burn injuries: Etiologies, risk factors and impact on institutional resources

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ABSTRACT

Introduction: Self-inflicted burns are a rare cause of injury, accounting for only 1.0% of burns in the United States. While rare, the physical and psychosocial ramifications of these injuries are lasting. The goal of this study was to examine the etiologies, risk factors and outcomes of self-inflicted burns in an urban setting.

Methods: Records of all patients presented to a regional burn center from July 2011 to June 2015 were reviewed. Those who sustained a self-inflicted burn were identified and included in this study. Demographic data, psychiatric history, previous self-harm records, insurance status, injury circumstance, burn characteristic [location and total body surface area (TBSA)], need for excision and grafting, graft-take and duration of hospital stay and costs were reviewed. This group was then compared to a cohort of 166 patients with non-intentional burn during the same time frame matched for age and TBSA%.

Results: There were 34 patients with a mean (SD) age of 31 (15.2) who sustained a self-inflicted burn during the study period. The mean TBSA% was 2.8 (SD=5.1), with most injuries in the upper and lower extremities. Fifty three percent of the patients presented with altered mental status secondary to either psychiatric illness or intoxication. Twenty-four percent of incidents were claimed as suicide attempts and suicidal ideation was present in 47% of cases. Twenty-six percent of patients with a previous psychiatric diagnosis were not on a psychiatric medication prior to incident. There was record of previous self-harm in 26% of patients. When compared to control group of 166 patient with non-intentional burn, patients with self-inflicted burn had higher rates of substance abuse (35% vs. 13%, $p<0.05$), longer stay in the hospital (11.3 vs. 5.3 days, $p<0.01$), longer stay in the intensive care unit (1.8 vs. 0.2 days, $p<0.01$), and lower rates of insurance (15% vs. 42%, $p<0.001$). These patients also exhibited a higher need for excision and grafting (41% vs. 20%, $p<0.01$).

Conclusions: Patients with self-inflicted burn have a higher rate of previous self-harm behavior, psychiatric comorbidities and substance abuse. These patients are more likely to require surgical excision and grafting and expanded institutional resources compared to those with non-intentional burn with similar degree and size of burn. Increased counseling of at-risk populations may help to decrease this potentially preventable method of injury.

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Applicability of research to practice

The self-inflicted burn population presents with avoidable injuries, requiring a high level of acute and chronic care. Early psychiatric and social work involvement, while not the focus of this study, is a prudent care management tool in this setting. Targeted counseling for at-risk patients is suggested to reduce primary and recurrent self-inflicted burn injuries.

1. Introduction

Self-inflicted (SI) burns are non-accidental and occur in the context of attempted suicide or deliberate self-harm. They remain a relatively rare phenomenon in the United States, with only 1.0% of reported burns classified as self-inflicted between 2006–2015 [1]. Patients who suffer from self-inflicted burns represent a population in which early recognition and intervention could have a positive impact on patient health and well-being.

One study reviewing a national cohort of burn patients reported that SI burn patients had a mean age of 39 years, and majority were white (69%) and males (66%). The median length of hospital stay was 23 days [2]. The most commonly reported etiology for self-inflicted burns were fire/flame or inhalation (93%) [2], most commonly occurring in the home (50%), with 28% occurring in an institutional setting such as a hospital or prison [3]. The average total body surface area (TBSA) % burned was 32% [2]. Unemployment is common among patients with SI burns, ranging from 36% to 85% in the studies reviewed [4–6].

The low prevalence of SI burns presents a major obstacle in designing studies with large enough sample sizes to accurately assess whether these patients fare better or worse than their non-intentional (NI) counterparts. A study conducted by Thombs and Bresnick using data from the National Burn Repository included 593 SI burn patients and over 30,000 burn patients in total. This study found that patients with SI burns had larger total body surface area (TBSA) burned and larger third-degree TBSA burned. It is important to note, however, that after propensity score matching for demographic, medical, and burn variables, SI burn victims were not more likely to die of their injuries, require longer intensive care stays, or require longer total hospital stays [2]. This indicates that patients with SI burns fare similarly to NI burns in the hospital setting.

This conclusion, however, does not address the demand on resources in the outpatient setting. Burn patients have been noted to have higher rates of premorbid psychopathological disorders, which result in longer and more costly recovery periods [7]. Dyster-Aas et al. found that two-thirds of burn survivors exhibited a lifetime psychiatric history and were at a higher risk of post-burn psychiatric problems, specifically depression [8]. Fauerbach et al. state that patients with a pre-burn affective disorder were at a greater risk of developing posttraumatic stress disorder and in turn a greater length of stay [9]. In addition, a history of depression is associated with lower self-esteem three months post-burn and in turn depressive symptoms six months post-burn in patients with facial burns [10]. Many burn patients will require psychiatric care to cope with their injuries, and the degree to which they require these services may relate to a prior history of psychiatric illness.

Previous studies estimate that between 45% and 75% of patients with SI burns had a previous diagnosis of psychiatric illness, and between 38% and 86% were known to mental health services prior to admission for a self-inflicted burn [3–6,11]. All of these studies, however, have a small sample size that limits their generalizability. Thombs and Bresnick reported that prior to propensity score matching the rate of psychiatric illness in the SI burn population was almost 10 times that noted in the non-SI group; this difference became non-significant following propensity score matching [2]. There is scant data in the literature reporting the prevalence of specific psychiatric diagnoses in the SI burn population. The small study conducted by Horner et al. noted that 33% of SI burn patients had a primary diagnosis of depression, 19% of personality disorder, and another 19% of schizophrenia [3]. It remains unclear whether patients with SI burns have a higher proportion of pre-existing psychiatric illness in general or specific psychiatric diagnoses compared to NI burn patients. Given the increased risk of post-burn psychiatric symptoms for patients with pre-burn psychiatric diagnoses noted above, determining the prevalence of pre-burn psychiatric illnesses relative to the general burn population could help predict the resources these patients will require as well as target those that are the greatest risk for self-harm by burning.

Given the limited size of many studies reporting on self-inflicted burns it is important to continue generating data to further characterize the nature of these injuries and the patients who suffer from them. The goal of this study is to add to that body of literature by examining the various etiologies, risk factors, and outcomes for self-inflicted burns in an urban setting. In doing so we hope to accurately characterize at-risk patients in order to focus preventive interventions.

2. Methods

2.1. Study design and settings

This study was completed with a retrospective chart review, and was conducted through the Department of Surgery at the University of Rochester, a regional burn center in Upstate New York. The institutional Burn Registry was interrogated and patients sustaining a self-inflicted burn between July 2011 and June 2015 were identified and included in this study. Patients were excluded if they were younger than 18 years old or if they were a planned readmission for a previous self-inflected burn.

A control group of patient was selected from those with non-intentional burn who were admitted to our center during the same time frame and matched for age and TBSA%.

2.2. Data collection and definitions

The following data points were extracted for all patients from the Burn Registry: demographics (age, sex, marital status, employment status and ethnicity), medical and psychiatric comorbidities, insurance status, injury circumstance, previous self-harm history, burn location, total burn surface area

(TBSA) %, burn mechanism, hospital length of stay, intensive care unit length of stay, insurance status, need foe excision and grafting and graft-take. Psychiatric history was obtained from patients' record during evaluation by the psychiatric providers. Patients were considered employed if they had a part time or full time job. Cost data was extracted from our Burn Registry database provided from hospital accounting.

2.3. Statistics

Values are reported as mean and standard deviation (SD). The Mann–Whitney *U* test was used to compare continuous variables between the two groups. The Kruskal–Wallis test was used for more than two groups, and the chi-square test was used to assess differences between categorical variables. A p value less than 0.05 was considered statistically significant. The analysis was performed using Prism 4 statistical software (Graphpad, San Diego, CA, USA). The study was approved by the Institutional Review Board.

3. Results

3.1. Study groups

There were 34 patients who sustained self-inflected burn injury during the four year study period. The non-intentional control group consisted of 166 burn patients managed for a non-intentional burn in the same time frame in our center and were matched for age and TBSA%. Demographic data for these two groups are shown in Table 1. None of the patients in the self-inflected group was married at the time of injury, with one (2.9%) being divorced and only four (12%) in a relationship. Only four of the patients with self-inflected burn were employed (12%) at the time of incident.

3.2. Burn characteristics

More than half (56%) of the patients presented over 24 h after the time of injury. The mechanisms of injury for self-inflicted and non-intentional burn groups are compared in Table 2. Fire/flame was the most common mechanism in both groups. The most common site of burn in the self-inflected burn was upper extremity (Table 3).

The mean TBSA% for patients with self-inflected burn was 2.80% (SD=5.14) and was 2.9% (SD=2.05) for the non-intentional burn group. Further, the mean TBSA% with 3rd degree burn was 0.67% (SD=1.01) in the self-inflected burn group and 0.71% (SD=0.95) in the non-intentional control group.

3.3. Previous psychiatric history

In the self-inflected burn group, 15 patients (44%) were reported to have impulsively burned themselves. The remaining 19 patients had planned the act. In addition, seven patients (24%) sustained their burns in an attempted suicide, and eight patients (26%) had previously attempted suicide. Further, sixteen patients (47%) were reported to have suicidal ideations. Of note, none of the seven patients who had attempted suicide had a previously reported suicide attempt. Eighteen patients (53%) presented with altered mental status secondary to either psychiatric illness or intoxication.

Psychiatric history was available for 33 of 34 patients in the self-inflicted burn group. Twenty-seven patients (82%) had a previous psychiatric diagnosis, with 18 (55%) having two or more diagnoses. Of the 34 total patients, 59% had a previously recorded psychiatric admission and 21% had a confirmed history of substance abuse. In contrast, only 11% of patients in the non-intentional burn group had a previous psychiatric diagnoses. Table 4 compares the previous psychiatric diagnoses among self-inflicted and non-intentional burn groups.

Prescription information was available for 33 patients in the self-inflected group. Among those patients 55% (n=18) were on psychiatric medication. Of note, seven patients (26%) with a previous psychiatric diagnosis were not on a psychiatric medication. A large majority of those on medication (78%) had $\geq$2 prescriptions. The most commonly prescribed classes of drugs were anti-psychotics and anti-depressants. A breakdown of the major classes of drugs prescribed to SI patients can be found in Fig. 1.

Antidepressant prescriptions included SSRIs (n=9), tricyclic antidepressants (n=1), and atypical antidepressants (n=2). All anti-anxiety medications prescribed were of the benzodiazepine class (n=6). Two of the 16 anti-psychotics prescribed were typical while 14 were atypical. Five patients were prescribed sedatives. Six patients were prescribed mood stabilizers.

3.4. Hospital stay, extent of treatment and discharge destination

The length of hospital and ICU stay and frequency of surgical interventions between the two groups are compared in Table 5. Although the severity of burn was similar between the two groups, patient with self-inflected burn had longer hospital

Table 1 – Demographic data for self-inflicted and non-intentional burn cohorts.

Variable	Self-inflicted (n=34)	Non-intentional (n=166)	p*
Age, mean (SD)	31.0 (15.2)	30.9 (9.0)	0.65
Female, n (%)	18 (53)	46 (28)	0.0041
Ethnicity, n (%)			
White	27 (79)	134 (81)	–
Black	5 (15)	24 (14)	–
Hispanic	2 (6)	4 (2.4)	–
Asian	0 (0)	3 (1.8)	–
Other	0 (0)	1 (0.6)	–

Table 2 – Mechanisms of injury for self-inflicted and non-intentional burn groups.

Mechanism	Self-inflicted (n=34) N (%)	Non-intentional (n=166) N (%)	p
Fire/flame	14 (41)	62 (37)	0.67
Scald	2 (5.9)	47 (28)	–
Contact with a hot object	6 (18)	8 (4.8)	0.0076
Chemical	1 (2.9)	6 (3.6)	–
Electrical	0 (0.0)	5 (3.0)	–
Excessive cold	5 (15)	5 (3.0)	0.0044
Other/unknown	6 (18)	33 (20)	0.76

Table 3 – Self-inflicted burn sites.

Burn site	N (%)
Upper extremity	23 (68)
Lower extremity	11 (32)
Back/flank	6 (18)
Face	6 (18)
Chest	3 (8.8)
Abdomen	2 (5.9)

and ICU stay and the need for surgical intervention was higher in them. There was no mortality in either group.

In the self-inflected group 19 patients (56%) were discharged home with no home health care, six (18%) were discharged home with home health care, two (5.9%) were discharged to a nursing home or skilled nursing facility (SNF), one (2.9%) was transferred to another hospital, four (12%) were admitted to inpatient psychiatry, one (2.9%) was discharged to jail/prison, and one (2.9%) was unable to complete treatment. Among the non-inflicted group 71 patients (43%) were discharged home with home health care, 88 (53%) were discharged home with home health care, two (1.2%) were discharged to a nursing home (SNF), non were transferred to another hospital, one (0.60%) was admitted to inpatient psychiatry, two (1.2%) were discharged to jail/prison, one (0.60%) was unable to complete treatment, and one (0.60%) was discharged to an alternate caregiver (Fig. 2).

Table 4 – Previous psychiatric diagnoses among self-inflicted and non-intentional burn groups.

	Self-inflicted (n=33) N (%)	Non-intentional (n=166) N (%)	p
Previous psychiatric diagnosis	27 (79)	19 (11)	<0.0002
Diagnosis			
Major depressive disorder	14 (42)	–	–
Anxiety	7 (21)	–	–
Schizophrenia	2 (5.9)	–	–
Schizoaffective disorder	2 (5.9)	–	–
Bipolar	7 (21)	–	–
Borderline PD	6 (18)	–	–
Eating disorder	3 (8.8)	–	–
Alcoholism	1 (2.9)	5 (3.0)	–
Drug abuse	3 (8.8)	14 (8.4)	–
Unspecified	0 (0.0)	5 (3.0)	–

PD: personality disorder.

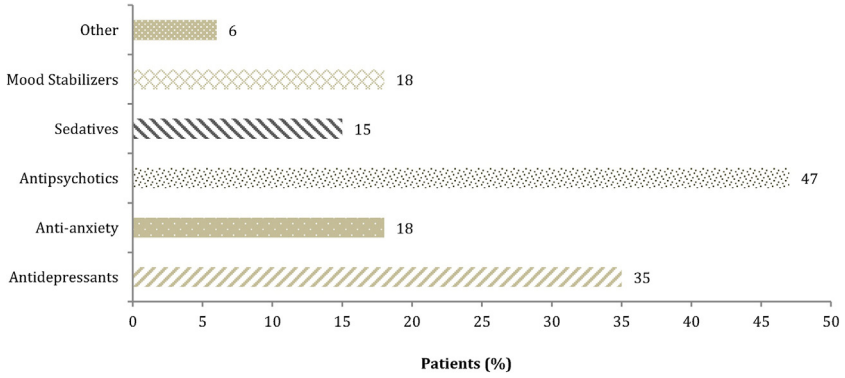

Fig. 1 – Percentage of patients on each major class of psychiatric medication (n=33).

Table 5 – Length and extent of treatment.

	Self-inflicted, mean (SD) (n=34)	Non-intentional, mean (SD) (n=166)	p
Hospital stay (days)	11 (23)	5.1 (5.3)	0.002
ICU stay (days)	1.8 (7.4)	0.16 (1.44)	0.007
OR visits (no.)	0.6 (1.2)	0.23 (0.44)	0.015
Procedures (no.)	1.2 (3.3)	0.45 (1.02)	0.012

ICU: intensive care unit, OR: operating room.

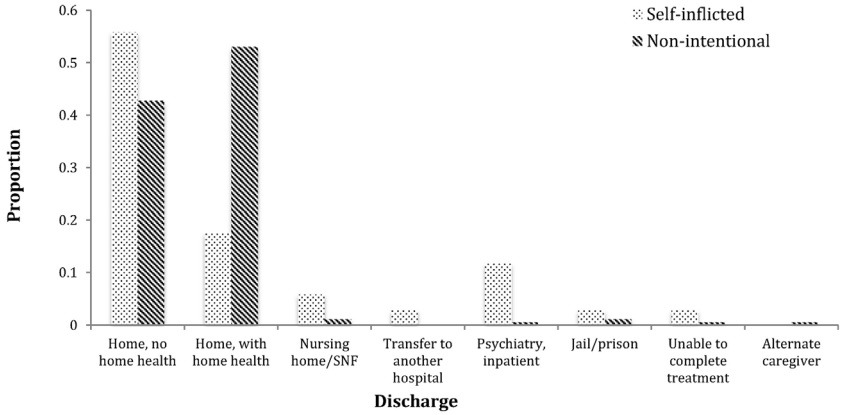

Fig. 2 – Discharge destinations for SI (n=34) and NI (n=166) burn patients.

Self-inflected burn patients were less likely to have commercial insurance than non-intentional burn patients (15% vs. 42%, $p<0.005$). The mean hospital charges for those in the self-inflicted burn group were also higher than for those in the non-intentional burn group [$31,486.12 (SD=48,852); $13,218.10 (SD=15,642.75); $p<0.001$].

4. Discussion

The primary aim of this study was to examine the etiologies, risk factors, and outcomes for patients with self-inflicted burns compared to a control group of non-intentional burn victims matched for age and TBSA burned at an urban regional burn center. There were differences between these groups that can inform future treatment and management of self-inflicted burn patients.

Analysis of SI burn etiology may help better characterize the nature of these injuries. Statistical comparison of burn etiologies was limited between self-inflected and non-intentional burn groups due to the small sample sizes involved. Flame was the most likely burn etiology among both self-inflected and non-intentional burn groups, with no difference between the two. Self-inflected group burns were more likely to be caused by contact with a hot object ($p<0.01$) and excessive cold ($p<0.005$). The upper and lower extremities were the most common site of self-inflected burns, however, facial burns were also very prevalent among this population (18%). Facial burns in particular may have more severe post-burn ramifications on self-esteem, especially given a pre-existing psychiatric history [10]. Burn location was not reported for non-intentional burn patients, preventing comparison of the two groups.

A greater proportion of self-inflicted burn patients had a pre-existing psychiatric condition than those with non-intentional burns ($p<0.0002$). This may be a novel finding in a study that compared TBSA and age-matched SI and NI burn patients. Depression, substance abuse, anxiety disorder, and personality disorder are examples of common psychiatric risk factors for general self-harm, with depression being the most common [12]. Among our own self-inflicted burn group, depression was also the most common diagnosis (42%). The next most common psychiatric disorders were anxiety (21%) and borderline personality disorder (21%). This data indicates that among our study population, psychiatric diagnoses that put one at risk factors for self-inflicted burns are similar to those for general self-harm.

Of particular interest in our study was the rate of previous encounters with the psychiatric services. Among the SI burn group 55% of patients were on a psychiatric medication and 59% had a previous psychiatric admission. This data is critical from an interventional standpoint. A majority of the patients in the self-inflicted burn group had previously interfaced with psychiatric medicine. Improved identification of self-inflicted burn risk based on validated risk measures would allow for preventive interventions such as more intensive psychiatric therapy and social work. There is also some evidence to indicate that these SI burn patients were either under-prescribed or non-compliant with psychiatric medication. In addition, a greater proportion of self-inflicted burn patients (26%) with previously diagnosed psychiatric disorder were not currently on a psychiatric medication when compared to non-intentional

burn patients (16%). Unfortunately, sample sizes were too small to evaluate the statistical significance of this data. Further research should examine differences in prescribing patterns and patient compliance between these two groups.

Prevention of self-inflicted burns is especially important given that in this study they were more likely to result in a longer period of medical care and greater expense when compared to the non-intentional burn group. Our study shows that self-inflicted burn patients on average had longer hospital stays ($p<0.005$), longer ICU stays ($p<0.01$), more operations ($p<0.05$), and a greater number of procedures ($p<0.05$). Self-inflicted burn patients also had higher average hospital charges ($p<0.001$) than non-intentional burn patients. Self-inflicted burn patients were also less likely to have commercial insurance than non-intentional burn patients ($p<0.005$), indicating that they may also represent a greater financial burden on the medical system than non-intentional burn patients. Barring the psychosocial ramifications of self-inflicted burn injuries; these patients demand more resources than typical burn victims, further emphasizing the importance of pre-burn intervention and prevention.

Patients in the self-inflicted burn group were more likely to be female than those in the non-intentional burn group ($p<0.005$). This differs from other studies that found no difference in gender between the two groups [2,5,11]. It does, however, mirror the gender demographics of patients who preform general self-harm [12]. This result may be due to the relatively small sample size used for this study. In addition, the patient demographics of this particular regional burn center may differ from those used in previous studies. Whites were the most common patients among both burn groups. This may also represent the demographics of the region this particular burn center serves, or the small sample size of the study. While employment information was not available for non-intentional burn group patients, it is important to recognize the high rate of unemployment (88%) among the SI burn group. This high rate of unemployment may be a symptom of pre-existing psychiatric illness, or perhaps a factor leading to the worsening of psychiatric symptoms. There is evidence to suggest that socioeconomic status can directly affect the development of mental illness [13]. Marital status was also unavailable for the non-intentional burn group. Interestingly, however, 100% of patients in the SI group were single. In a review of the literature surrounding mental health and marital status, one study found that mental health is both a consequence and cause of marital status [14]. While the risk of self-harm is reported to be 11 times higher for separated and divorced people than those not in this category (only one patient in our study was divorced), it is yet to be determined whether married individuals are more likely than single individuals to self-harm [12].

Taken together, this demographic data can inform clinicians regarding risk factors for self-inflicted burns. There is an interplay of factors such as gender, psychiatric illness, employment status, and marital status. These variables may increase the likelihood of self-harm by thermal energy. As mentioned above, a history of depression is also negatively correlated with self-esteem three months post non-intentional facial burn, and as a result depressive symptoms six months post burn [10]. These results underline the need for psychiatric care among this population in order to prevent self-inflicted burns in the first place, but also to deal with the psychological impact that they may have after the event has occurred.

The authors of this study attempted to complete and in-depth analysis of SI burns. Unfortunately, there are several limitations that impact its comparability to other studies addressing the topic, as well as its generalizability and applicability to clinical practice. Limitations of this study include but are not limited to: its retrospective nature, dependence on patient health records, and perhaps most importantly its small sample size. With respect to generalizability to clinical practice, it should be noted that the mean percent TBSA for both SI and NI burn groups were small. We are unable to determine if similar results would be found in a patient population with significantly larger burns. Larger burns would likely result in poorer outcomes, longer hospital stays, and greater resource consumption among patients studied. TBSA may not, however, have a large impact on the overall risk factors for self-inflicted burns.

The limitations outlined above highlight the need for large multi-center studies on self-inflicted burns in order to accumulate large enough sample sizes from which meaningful and clinically applicable conclusions can be drawn. This would allow for stratification of variables so that researchers can better identify risk factors that have the greatest influence on propensity to self-harm. This data could be used to develop tools that stratify patients based on their risk of self-harm and guide early intervention and treatment. The efficacy of potential interventions implemented using such risk stratification will also need to be assessed and validated, including early psychiatric counseling and social work.

Self-inflicted burns patients are likely to have definable risk factors, which may be used clinically to identify patients with a greater need for interventions such as psychiatric counseling and social work. Most importantly, the data above further characterizes the complexity of self-inflicted burn patients. Self-inflicted burn patients in this study demanded a greater number of resources and had longer hospital stays than typical burn victims, and were more likely to require follow-up care after discharge. Further research is needed to better characterize the etiology and outcomes of these patients, as well as determine strategies to prevent these injuries from occurring at all.

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Conflicts of interest

None.

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