Published in final edited form as:

Burns. 2017 November ; 43(7): 1493–1498. doi:10.1016/j.burns.2017.03.030.

The influence of substance misuse on clinical outcomes following burn[☆]

Sarah Rehou^a, Stephanie Mason^{a,b}, Jessie MacDonald^c, Ruxandra Pinto^d, Marc G. Jeschke^{a,e,f,*}

^aRoss Tilley Burn Centre, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada

^bDivision of General Surgery, Department of Surgery, Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada

^cFaculty of Medicine, University of Toronto, Toronto, Ontario, Canada

^dDepartment of Critical Care Medicine, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada

^eDivision of Plastic and Reconstructive Surgery, Department of Surgery, Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada

^fDepartment of Immunology, Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada

Abstract

Introduction: Ongoing increases in the prevalence of substance misuse among burn-injured patients necessitate a contemporary analysis of the association between substance misuse and clinical outcomes in burn-injured adults.

Methods: We conducted a retrospective cohort study of 1199 patients admitted to a regional burn center. History of substance misuse was derived from a prospective clinical registry and categorized as alcohol, illicit drug, or both. The primary outcome was hospital length of stay; association of substance misuse and inpatient complications were secondary outcomes.

[☆]Abstract presented at the 47th Annual Meeting of the American Burn Association. April 21–24, 2015; Chicago, Illinois.

*Corresponding author at: Sunnybrook Health Sciences Centre, 2075 Bayview Ave. D7 04, Toronto, ON M4N 3M5, Canada. Fax: +1 416 480 6763. marc.jeschke@sunnybrook.ca (M.G. Jeschke).

Author contribution

Ms. Rehou had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Rehou, Jeschke.

Acquisition, analysis, or interpretation of data: Rehou, Mason, MacDonald, Pinto, Jeschke

Drafting of the manuscript: Rehou, Mason, Jeschke.

Critical revision of the manuscript for important intellectual content: Rehou, Mason, MacDonald, Pinto, Jeschke.

Statistical analysis: Rehou, Pinto.

Obtained funding: Jeschke.

Administrative, technical, or material support: Rehou, Mason, MacDonald, Pinto, Jeschke.

Study supervision: Rehou, Jeschke.

Conflict of interest

The authors declare that they have no conflict of interest.

Disclosure summary

The authors have no disclosures to report.

Multivariable logistic regression was used to model the association between categories of substance misuse and each outcome, adjusting for patient and injury characteristics.

Results: The incidence of substance misuse was 34% overall. After adjustment for patient and injury characteristics, drug misuse was associated with a significantly longer length of stay (RR 1.12; 95% CI 1.00–1.25), as was alcohol misuse (RR 1.32; 95% CI 1.14–1.52), and drug/alcohol misuse (RR 1.34; 95% CI 1.16–1.56). Drug/alcohol misuse was associated with significantly higher rates of bacteremia (OR 3.84; 95% CI 1.83–8.04) and sepsis (OR 2.50; CI 1.13–5.53).

Conclusions: A history of substance misuse is associated with an increased risk of inpatient complications and longer hospital stay. Providers should be cognizant of increased complications in this cohort with a view to improving outcomes.

Keywords

Burns; Substance-related disorders; Alcohol-related disorders

1. Introduction

Thermal injury affects an estimated 450 000 people annually in the United States and accounts for approximately 3000 deaths [1]. A host of risk factors for burn have been identified, including age, gender, socioeconomic status, and comorbidity [2]. More specifically, substance misuse is a known risk factor for burn and other traumatic injuries [3,4].

The U.S. Department of Health and Human Services' recent national survey found 24.6 million people (9.4%) in the US, aged 12 or older, have used illicit drugs in the past month, and that the current rate of illicit drug use is significantly higher than rates observed in previous years [5]. Similar trends have been observed among burn patients; the proportion of patients that tested positive for cannabis increased from 6% in 2002 to 27% in 2011 [6]. Some studies report that these patients have increased length of stay [7,8] and increased mortality [9] compared with those who did not abuse drugs.

Alcohol is implicated in more than 50% of burns, and intoxicated patients suffer from more extensive burns and an increased likelihood of inhalation injury compared with non-intoxicated burn patients [7,10–12]. Previous studies have attempted to elucidate the effects of acute alcohol exposure on burn by focusing on patients who exhibit binge drinking. These studies demonstrate that patients who are intoxicated at the time of injury have increased ventilator days, fluid resuscitation volumes, and rates of complications such as graft loss, cellulitis, and pneumonia [7,10,11,13,14]. In corresponding animal studies, intoxication at the time of burn leads to fluid retention and impairment of the gut-liver axis; this might predispose patients to graft loss, compartment syndrome, pulmonary complications, and worsen end-organ ischemia [15–18].

Although there is an abundance of literature exploring alcohol misuse in burn-injured patients, remarkably little research has been undertaken to understand the implications of drug misuse. Additionally, there is a dearth of research on concurrent drug and alcohol misuse. Further concern comes from the increase in illicit drug use [5] and impending

legalization of particular drugs [19–21]. Existing studies on drug misuse in burn-injured patients report contradictory results, the interpretation of which is limited by small cohort sizes, poor risk adjustment, and/or focus on mortality as a primary outcome. Moreover, studies that did include concurrent drug and alcohol misuse did not differentiate between acute intoxication and those with a history of alcohol abuse [7,9,11]. Such evidence lends support for the need to better understand recent trends in drug misuse, alcohol misuse, or both drug and alcohol misuse. The potential impact of drug misuse on other important patient-level outcomes and the effects of combined drug and alcohol use on morbidity and mortality in burn patients are largely unknown.

The aim of this study is to determine the association between substance misuse, specifically drug misuse, alcohol misuse, or both drug and alcohol misuse, on burn patient outcomes. We hypothesized that burn patients with a history of substance misuse have a longer length of stay and increased rates of complications than burn patients with no history of substance misuse.

2. Methods

2.1. Study design and participants

A retrospective cohort study was conducted among burn patients admitted between 2006 and 2014 to our regional burn center. Adult patients (≥16 years of age) were identified from our prospective burn registry. To capture initial acute admissions for burn, patients were included if admitted within seven days of burn. Patients who died within 72h of admission were considered futile and therefore excluded from the analysis. The study protocol was approved by the research ethics board at our institution.

Data were obtained from a prospective clinical registry of all patients admitted to our burn center. Substance misuse was defined as self- or family-reported drug misuse or alcohol misuse and recorded as a comorbidity in our registry. The attending burn staff or other trained members of the burn team, such as our burn dedicated social worker, identified substance misuse on admission and during the patient history. Furthermore, patients admitted to our burn center undergo toxicology screens on admission; a positive toxicology was considered drug misuse. We defined drugs of misuse to include any of the following: cannabis, marijuana or hashish; amphetamines, cocaine, crack, or methamphetamines; opiates, heroin; hallucinogens or dissociative agents. Substance misuse was indicated based on the World Health Organization's definition: use of a substance in opposition to medical or legal guidelines [22]. For the purposes of our analysis, tobacco smoking was not considered drug misuse and as such, smokers are represented in all groups.

Patients were assigned to one of four groups: (1) no substance misuse (controls), (2) drug misuse, (3) alcohol misuse, and (4) drug misuse and alcohol misuse (drug/alcohol misuse). The primary outcome was hospital length of stay (LOS). Secondary outcomes included the incidence of each the following inpatient complications: in-hospital bacteremia, sepsis, cellulitis, acute respiratory distress syndrome (ARDS), and pneumonia.

2.2. Statistical analysis

The data are reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement [23]. Categorical data were analyzed using the Fisher's exact or χ^2 test. Normally distributed continuous variables were analyzed using the Student's t-test or one-way ANOVA and non-normally distributed variables were analyzed using the Mann–Whitney U or Kruskal–Wallis test, followed by pair-wise post-hoc analysis. Data are presented as mean (SD) for normally distributed continuous variables, median (IQR) for variables with a non-normal distribution, or number (%) as appropriate. To examine the association between drug, alcohol, and drug/alcohol use, and each outcome, individual regression models were developed. Covariates chosen a priori for each regression model were continuous variables, that included patient age and % total body surface area (TBSA) burn, and categorical variables, that included patient gender and inhalation injury. Subgroup analyses were conducted to identify effect modification. Negative binomial linear regression was employed to model the count nature of LOS. A logistic regression analysis was conducted on the dichotomous outcomes of bacteremia, sepsis, cellulitis, ARDS, and pneumonia. Model calibration was assessed using the Hosmer and Lemeshow test. All tests were 2-tailed, with a p value of <0.05 considered statistically significant. Analyses were performed using SPSS Statistics version 20.0 (IBM Corp., Armonk, NY).

3. Results

3.1. Patient demographics

A total of 1199 patients were identified for inclusion in the study (see Supplemental Fig. S1 in the online version at DOI:[10.1016/j.burns.2017.03.030](https://doi.org/10.1016/j.burns.2017.03.030)). Baseline patient demographics and injury characteristics are summarized in Table 1. The median age was 44 (IQR 30–58) years and the majority of patients were male (74%). Flame burns were the most common mechanism of injury, responsible for 60% ($n=723$) of injuries. The median TBSA burn was 8% (IQR 4–17), LOS was 13days (IQR 6–21 days) and 1.5 days per percent TBSA burn (IQR 0.9–2.5 days per percent TBSA burn). Inhalation injury occurred in 189 (16%) of patients.

Table 1 shows the clinical characteristics of patients divided into groups based on their substance misuse: controls ($n=794$; 66%), drug ($n=205$; 17%), alcohol ($n=103$; 9%), and drug/alcohol ($n=97$; 8%). A significant difference in age was observed among the four groups (Table 1). Pairwise post-hoc comparisons with adjusted p -values demonstrate that the drug group was significantly younger compared with controls ($p=0.002$) and alcohol ($p<0.001$), but there was no significant difference compared with drug/alcohol ($p=1.000$). Patients that misused alcohol group were significantly older compared with controls ($p=0.010$) and drug/alcohol ($p=0.001$). There were no significant differences in age between drug/alcohol and controls ($p=0.462$) (Table 1). There was a significant difference in TBSA among groups (Table 1). Patients that misused drugs had significantly more extensive injuries compared with patients that misused alcohol ($p=0.008$) and compared with controls ($p<0.001$). There was no significant difference in median TBSA between the drug and drug/alcohol group, alcohol and control group, or alcohol and drug/alcohol groups (Table 1). Patients in the drug/alcohol group had a significantly higher TBSA than controls ($p<0.001$).

There was a significant difference observed among the groups for bacteremia, sepsis, ARDS, and pneumonia ($p < 0.001$ respectively; see Supplemental Fig. S2 in the online version at DOI: [10.1016/j.burns.2017.03.030](https://doi.org/10.1016/j.burns.2017.03.030)). No difference in outcomes between tobacco smokers and non-smokers were observed on univariate analysis (data not shown). While futile patients were excluded from the overall analyses, there was no significant difference in the number of patients that were considered futile in each group: controls ($n=31$; 4%), drug ($n=9$; 4%), alcohol ($n=3$; 3%), and drug/alcohol ($n=4$; 4%) ($p=0.994$).

3.2. Association of substance misuse with LOS

After adjusting for patient characteristics and injury severity, there was an association between increased LOS and drug (RR 1.12; 95% CI 1.00–1.25), alcohol (RR 1.32; 95% CI 1.14–1.52), and drug/alcohol (RR 1.34; 95% CI 1.16–1.56) misuse compared with controls. Other significant predictors of increased LOS included increased TBSA, increased age, female gender and inhalation injury (Table 2).

3.3. Association of substance misuse with complications

When comparing our secondary outcomes of interest, neither drug (OR 1.49; 95% CI 0.82–2.73) nor alcohol (OR 0.86; 95% CI 0.36–2.04) misuse alone was associated with bacteremia, while drug/alcohol misuse was associated with significantly higher rates of bacteremia (OR 3.84; 95% CI 1.83–8.04; Table 3). Similarly, neither drug (OR 1.83; 95% CI 0.97–3.46) nor alcohol (OR 1.70; 95% CI 0.75–3.86) misuse alone were associated with sepsis, whereas there was a significant association between drug/alcohol and sepsis (OR 2.50; CI 1.13–5.53) (Table 4). Neither drug (OR 1.24; 95% CI 0.85–1.82), alcohol (OR 1.55; 95% CI 0.98–2.43), nor drug/alcohol (OR 1.50; 95% CI 0.92–2.45) misuse had a significant association with cellulitis (see Supplemental Table S1 in the online version at DOI: [10.1016/j.burns.2017.03.030](https://doi.org/10.1016/j.burns.2017.03.030)). There was no association with drug misuse (OR 1.64; 95% CI 0.80–3.38) and ARDS, but there was a significant association with alcohol (OR 2.75; CI 1.20–6.31) and ARDS (see Supplemental Table S2 in the online version at DOI: [10.1016/j.burns.2017.03.030](https://doi.org/10.1016/j.burns.2017.03.030)). In contrast, there was a significant association with drug (OR 2.02; CI 1.26–3.25) and pneumonia, but no association with pneumonia and alcohol (OR 1.31; CI 0.69–2.51) (Table 5). Drug/alcohol misuse was not associated with either ARDS (see Supplemental Table S2 in the online version at DOI: [10.1016/j.burns.2017.03.030](https://doi.org/10.1016/j.burns.2017.03.030)) or pneumonia (Table 5). The Hosmer and Lemeshow goodness-of-fit test for ARDS ($p=0.008$) and pneumonia ($p=0.001$) suggested a potential lack-of-fit. However, additional methods, assessment of influential cases and classification accuracy, were employed and found to be satisfactory in both models. Accordingly, both models are presented with complete data.

4. Discussion

In this study, we demonstrated that patients who misuse drugs, alcohol, or drugs/alcohol were more likely to have an increased LOS. Initially, the difference in outcomes may be attributed to a greater burn size and incidence of inhalation injury; however, after adjustment for patient characteristics and injury severity patients that misuse drugs, alcohol, or drugs/alcohol still had a significantly greater LOS. Furthermore, drug/alcohol misuse significantly increased rates of bacteremia and sepsis.

Substance misuse is associated with a variety of physiological and psychosocial challenges that might impact a patient's clinical course after injury. Many substances can induce withdrawal when suddenly stopped, resulting in a spectrum of symptoms from mild seizures and hallucinations to death [24,25]. We have demonstrated that patients who misuse substances had more extensive burns and a higher incidence of inhalation injury, associated with an increased risk for complications following burn. These findings are consistent with prior studies that found substance misuse to be a risk factor for injury and trauma recidivism [12,26], and highlight the need to address substance misuse as an important target for future injury prevention efforts. Early recognition of alcohol misuse in patients by the multidisciplinary burn care team might result in improved patient care strategies, reduced morbidity and mortality, and, potentially, injury recidivism.

The increased LOS and poor outcomes among patients with substance misuse suggests that the combined effects of drug/alcohol misuse may impair a number of organ systems, ultimately leading to increased LOS and after-injury sequelae. Our results demonstrate a strong association between alcohol misuse and poor outcomes, even after adjusting for injury severity, and this association is consistent with other studies [7,10–12]. Additionally, our findings also demonstrate an association between poor clinical outcomes and drug misuse, and another association with drug/alcohol misuse. The association between alcohol misuse and ARDS is plausible given that intoxication increases fluid retention and pulmonary edema, known precursors to ARDS. Drug misuse alone was associated with increased risk of pneumonia in patients. This may be explained by risk factors for pneumonia such as a weakened immune system or malnutrition, both of which are commonly found with drug misuse [27–29].

Early recognition of substance misuse may be enhanced with the use of a standardized, objective screening mechanism that has been validated for use with critically ill patients. There are an abundance of successful screening tools for substance misuse, such as the alcohol use disorders identification test (AUDIT) or drug misuse screening test-20 (DAST) [25,30,31]. Studies have validated the completion of screening tools by proxy, thereby facilitating their use in critically ill patients who may be sedate or unconscious [30]. Burn care providers should also be aware of regional trends in drug misuse as differences in usage patterns may occur, such as prevalence of methamphetamine use or honey oil in different regions [32], and we do not yet know how specific patterns of substance use might impact outcomes, or if drug-specific clinical approaches are required.

We recognize several limitations of the current study. Inherent to any retrospective analysis, conclusions are limited to associations. This study relied on self- or proxy-reports of substance use and, as such, we may have underestimated the number of individuals with substance misuse. This underestimation may have been mitigated as we also included toxicology screens to identify drug misuse. Additionally, we did not include blood alcohol screening at the time of admission as our burn center treats patients admitted from a large geographical area and we reasoned that alcohol might have metabolized, making blood alcohol concentration an unreliable marker of alcohol misuse. Though commonly measured on admission for use as a surrogate marker, blood alcohol concentration is an inadequate screening tool for at-risk drinking, and should not be used for this purpose [25]. Other

indicators for alcohol-related liver disease may be suspected with abnormal results for liver function tests that include alkaline phosphatase (ALP), alanine transaminase (ALT), aspartate aminotransferase (AST), bilirubin, albumin, or gamma glutamyl transpeptidase (GGT). Another limitation is it was not possible to ascertain the nature, frequency, or severity of misuse (i.e. acute, chronic, or binge) or drug usage patterns (i.e. as class or amount) and determine how they impact outcomes. It is possible that drugs with short half-lives would have metabolized, misclassifying drug misuse as no substance misuse, or that toxicology screens included patients in the drug or drug/alcohol group who had a medical explanation for positive result. These types of misclassifications would bias the estimate toward the null, thus we expect it to have had a minimal effect. Finally, unmeasured confounding may account for the observed associations between substance misuse and outcomes; for example, injury severity is likely not completely accounted for through adjustment for TBSA and inhalation injury alone.

In summary, this retrospective analysis characterized the association between drug, alcohol, drug/alcohol misuse and clinical outcomes in a cohort of burn-injured patients. After adjustment for patient characteristics and injury severity, patients in these substance misuse categories are associated with increased length of stay and higher rates of assessed complications. Efforts to recognize substance misuse in these patients are warranted, as recognition might mitigate the impact of substance misuse on clinical outcomes. Future efforts should characterize the dose-response relationship between various usage patterns of substances and outcomes, and investigate whether the nature and severity of the substance have may have differential effects on outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

The authors would like to thank the Ross Tilley Burn Centre staff for their support.

Funding/support

Canadian Institutes of Health Research # 123336, Canada Foundation for Innovation Leader's Opportunity Fund: Project # 25407, National Institutes of Health RO1 GM087285-01. The funding organizations had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

REFERENCES

- [1]. American Burn Association. Burn incidence and treatment in the United States: 2016 fact sheet. URL: http://www.ameriburn.org/resources_factsheet.php 2016.
- [2]. Peck MD. Epidemiology of burns throughout the world. Part I: Distribution and risk factors. *Burns* 2011;7:1087–100.
- [3]. Barillo DJ, Goode R. Substance abuse in victims of fire. *J Burn Care Res* 1996;1:71–6.
- [4]. Hadfield R, Mercer M, Parr M. Alcohol and drug abuse in trauma. *Resuscitation* 2001;1:25–36.
- [5]. Abuse S Mental Health Services Administration (SAMHSA). Results from the 2013 National Survey on Drug Use and Health: summary of national findings, NSDUH Series H-48, HHS

Publication No. (SMA) 14–4863 Rockville, MD: Substance Abuse and Mental Health Services Administration; 2014.

- [6]. Jehle CC Jr., Nazir N, Bhavsar D. The rapidly increasing trend of cannabis use in burn injury. *J Burn Care Res* 2015;1:e12–7.
- [7]. Haum A, Perbix W, Häck H, Stark G, Spilker G, Doehn M. Alcohol and drug abuse in burn injuries. *Burns* 1995;3:194–9.
- [8]. Thombs BD, Singh VA, Halonen J, Diallo A, Milner SM. The effects of preexisting medical comorbidities on mortality and length of hospital stay in acute burn injury: evidence from a national sample of 31,338 adult patients. *Ann Surg* 2007;4:629–34.
- [9]. McGill V, Kowal-Vern A, Fisher SG, Kahn S, Gamelli R. The impact of substance use on mortality and morbidity from thermal injury. *J Trauma Acute Care Surg* 1995;6:931–4.
- [10]. Silver GM, Albright JM, Schermer CR, Halerz M, Conrad P, Ackerman PD, et al. Adverse clinical outcomes associated with elevated blood alcohol levels at the time of burn injury. *J Burn Care Res* 2008;5:784–9.
- [11]. Grobmyer S, Maniscalco S, Purdue G, Hunt J. Alcohol, drug intoxication, or both at the time of burn injury as a predictor of complications and mortality in hospitalized patients with burns. *J Burn Care Res* 1996;6:532–9.
- [12]. Choudhry MA, Chaudry IH. Alcohol intoxication and postburn complications. *Front Biosci* 2006;998–1005. [PubMed: 16146791]
- [13]. Griffin R, Poe AM, Cross JM, Rue LW 3rd, McGwin G Jr.. The association between blood alcohol level and infectious complications among burn patients. *J Burn Care Res* 2009;3:395–9.
- [14]. Davis CS, Esposito TJ, Palladino-Davis AG, Rychlik K, Schermer CR, Gamelli RL, et al. Implications of alcohol intoxication at the time of burn and smoke inhalation injury: an epidemiologic and clinical analysis. *J Burn Care Res* 2013;1:120–6.
- [15]. Li X, Akhtar S, Kovacs EJ, Gamelli RL, Choudhry MA. Inflammatory response in multiple organs in a mouse model of acute alcohol intoxication and burn injury. *J Burn Care Res* 2011;4:489–97.
- [16]. Chen MM, Zahs A, Brown MM, Ramirez L, Turner JR, Choudhry MA, et al. An alteration of the gut-liver axis drives pulmonary inflammation after intoxication and burn injury in mice. *Am J Physiol Gastrointest Liver Physiol* 2014;7:G711–8.
- [17]. Chen MM, O'Halloran EB, Ippolito JA, Choudhry MA, Kovacs EJ. Alcohol potentiates postburn remote organ damage through shifts in fluid compartments mediated by bradykinin. *Shock* 2015;1:80–4.
- [18]. Shults JA, Curtis BJ, Boe DM, Ramirez L, Kovacs EJ. Ethanol intoxication prolongs post-burn pulmonary inflammation: role of alveolar macrophages. *J Leukoc Biol* 2016;5:1037–45.
- [19]. Covey DP, Wenzel JM, Cheer JF. Cannabinoid modulation of drug reward and the implications of marijuana legalization. *Brain Res* 2015;1628(Pt A):233–43. [PubMed: 25463025]
- [20]. Bell C, Slim J, Flaten HK, Lindberg G, Arek W, Monte AA. Butane hash oil burns associated with marijuana liberalization in Colorado. *J Med Toxicol* 2015;4:422–5.
- [21]. Monte AA, Zane RD, Heard KJ. The implications of marijuana legalization in Colorado. *JAMA* 2015;3:241–2.
- [22]. World Health Organization. Abuse (drug, alcohol, chemical, substance or psychoactive substance) URL: http://www.who.int/substance_abuse/terminology/abuse/en/#.
- [23]. von Elm E, Altman DG, Egger M, Pocock SJ, Gotsche PC, Vandenbroucke JP, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *Lancet* 2007;9596:1453–7.
- [24]. Coffey R, Murphy CV. Effects of alcohol use and abuse on critically ill burn patients. *Crit Care Nurs Clin North Am* 2012;1:1–7.
- [25]. Albright JM, Kovacs EJ, Gamelli RL, Schermer CR. Implications of formal alcohol screening in burn patients. *J Burn Care Res* 2009;1:62–9.
- [26]. Guardia SC, Rodríguez-Bolaños S, López FG, Lara-Rosales R, Sánchez FP, Rayo A, et al. Alcohol and/or drug abuse favors trauma recurrence and reduces the trauma-free period. *Med Intensiva* 2013;1:6–11.

- [27]. Hall KL, Shahrokhi S, Jeschke MG. Enteral nutrition support in burn care: a review of current recommendations as instituted in the Ross Tilley Burn Centre. *Nutrients* 2012;11:1554–65.
- [28]. Mégarbane B, Chevillard L. The large spectrum of pulmonary complications following illicit drug use: features and mechanisms. *Chem Biol Interact* 2013;3:444–51.
- [29]. Wurcel AG, Merchant EA, Clark RP, Stone DR. Emerging and underrecognized complications of illicit drug use. *Clin Infect Dis* 2015;12:1840–9.
- [30]. Moss M, Burnham EL. Alcohol abuse in the critically ill patient. *Lancet* 2007;9554:2231–42.
- [31]. Salehi SH, As'adi K, Musavi J, Ahrari F, Nemazi P, Kamranfar B, et al. Assessment of substances abuse in burn patients by using drug abuse screening test. *Acta Med Iran* 2012;4:257–64.
- [32]. Jensen G, Bertelotti R, Greenhalgh D, Palmieri T, Maguina P. Honey oil burns: a growing problem. *J Burn Care Res* 2015;2: e34–7.

Table 1 –

Demographics, injury characteristics, and outcomes by substance misuse.

	All	Controls	Drug	Alcohol	Drug/alcohol	P
No. of patients	1199	794	205	103	97	
Age, years [*]	44 (30–58)	45 (31–59) ^a	40 (27–52) ^b	53 (42–61) ^c	44 (30–53) ^{a,b}	<0.001
Male, no. (%)	882 (74%)	570 (72%)	170 (83%)	70 (68%)	72 (74%)	0.007
TBSA [*]	8 (4–17)	6 (3–13) ^a	14 (7–28) ^b	8 (5–18) ^{a,c}	12 (6–29) ^{b,c}	<0.001
Inhalation injury, no. (%)	189 (16%)	77 (10%)	63 (31%)	16 (16%)	33 (34%)	<0.001
LOS [†]	13 (6–21)	12 (4–18)	16 (10–27)	16 (10–25)	18 (13–37)	<0.001
LOS/TBSA ^{*,†}	1.5 (0.9–2.5)	1.5 (0.9–2.6) ^{a,b}	1.3 (0.9–2.0) ^a	1.6 (1.0–3.2) ^b	1.8 (1.1–2.7) ^b	0.003
Ventilated, no. (%)	400 (33%)	200 (25%)	117 (57%)	34 (33%)	49 (51%)	<0.001
Ventilator days ^{*,†}	10 (2–22)	5 (1–18) ^a	11 (2–19) ^{a,b}	14 (4–33) ^b	15 (8–23) ^b	<0.001
Mortality, no. (%)	48 (4%)	28 (4%)	8 (4%)	7 (7%)	5 (5%)	0.407

Data presented as median (IQR) unless otherwise specified.

CI, confidence interval; TBSA, total body surface area.

^{*} Within this row, values not sharing a common superscript letter (a, b, or c) are significantly different (p<0.05), by pairwise post hoc analyses.

[†] Analysis restricted to patients alive until discharge.

[‡] Analysis restricted to patients that were on a mechanical ventilator.

Table 2 –

Association between substance misuse and length of stay in burn patients (N=1151).

Adjusted rate ratio (95% CI)	
Drug	1.12 (1.00, 1.25)
Alcohol	1.32 (1.14, 1.52)
Drug/alcohol	1.34 (1.16, 1.56)
TBSA	1.05 (1.04, 1.05)
Inhalation injury	1.38 (1.23, 1.55)
Age	1.01 (1.01, 1.01)
Female	1.29 (1.18, 1.41)

CI, confidence interval; TBSA, total body surface area.

Table 3 –

Association between substance misuse and bacteremia in burn patients (N=1199).

Adjusted odds ratio (95% CI)	
Drug	1.49 (0.82, 2.73)
Alcohol	0.86 (0.36, 2.04)
Drug/alcohol	3.84 (1.83, 8.04)
TBSA	1.14 (1.12, 1.16)
Inhalation injury	2.86 (1.70, 4.81)
Age	1.03 (1.02, 1.05)
Female	1.21 (0.71, 2.06)

CI, confidence interval; TBSA, total body surface area.

Table 4 –

Association between substance misuse and sepsis in burn patients (N=1199).

Adjusted odds ratio (95% CI)	
Drug	1.83 (0.97, 3.46)
Alcohol	1.70 (0.75, 3.86)
Drug/alcohol	2.50 (1.13, 5.53)
TBSA	1.10 (1.09, 1.12)
Inhalation injury	2.43 (1.42, 4.17)
Age	1.04 (1.02, 1.05)
Female	1.14 (0.65, 2.01)

CI, confidence interval; TBSA, total body surface area.

Table 5 –

Association between substance misuse and pneumonia in burn patients (N=1199).

Adjusted odds ratio (95% CI)	
Drug	2.02 (1.26, 3.25)
Alcohol	1.31 (0.69, 2.51)
Drug/alcohol	1.51 (0.78, 2.92)
TBSA	1.08 (1.06, 1.09)
Inhalation injury	4.83 (3.18, 7.35)
Age	1.03 (1.02, 1.04)
Female	0.95 (0.62, 1.47)

CI, confidence interval; TBSA, total body surface area.