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Work-related burn injuries in Ontario, Canada: a follow-up 10-year retrospective study

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Abstract

Work-related burn injuries contribute to a quarter of all burn injuries in USA. In 2009, the provincial Workplace Safety and Insurance Board reported 64,824 work-related injuries that resulted in time-lost, 1188 injuries (2%) were a result of burns. There have been two previous studies performed at a regional burn centre (1984-1990 and 1998-2000) looking at incidence and characteristics of work-related burns. There was no significant change between these two groups. The purpose of this study was to identify the recent pattern of work-related burns from 2001 to 2010 and to compare it to the previous studies.

During the study period, 1427 patients were admitted for an acute injury to the regional burn centre. Of these, 330 were due to a work-related incident (23%). The mean age of patients was 40.5±11.9 years, 95% were male. The mean total body surface area burn was 11.9±16.2%. The most common mechanism of burn injury was flame (32.7%) followed by electrical (27%) and scald (19.7%), inhalation injury was present in 4.8% of patients and the mortality was 1.8%.

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Conflict of Interest Statement
Declare no conflict of interest.

Our study has shown that there has been a significant decrease in the incidence in work-related burns treated at the regional burn centre (23.1%, vs. 28.2% vs. 30.2% $p<0.01$), flame burns have now become the leading cause of injury, there was a significant reduction in inhalation injury (4.8% vs. 23% vs. 14.8%, $p<0.00001$), and mortality overtime (1.8%, vs. 4% vs. 6.7% $p=0.02$). These findings strongly suggests a change in the cause of work-related burns, improvement in burn care, and that prevention strategies may have been more effective.

Keywords

work-related accidents; Burns; Burn unit; Ontario; Retrospective study

Background

Work-related injuries can be quite devastating to the person, their family and the workforce. In 2009, the provincial Workplace Safety and Insurance Board reported 64,824 work-related injuries that resulted in time-lost, 1188 injuries (2%) were a result of burns [1]. The National Health Interview Survey data from the United States, estimated that 42% of burn injuries are work-related [2], and the regional burn centre has reported 28% being work-related burns [3]. With such a large impact on burn occurrences, work-related burns should be a target for prevention.

Burn injuries can cause both physical and psychological trauma [4]. Physically, burns can cause pain, sensory problems, and weakness. Studies have shown that patients can develop depression and post-traumatic stress disorder after hospital discharge [5–7]. These factors can greatly affect a person's ability to return to work, and thereby impacting their financial income [8–11], especially after electrical burns [12]. A meta-analysis of 10 studies determined that the mean time off after a burn was 9.6 weeks, this was dependent on the size of the burn, age and some studies reported the presence of hand burns [13]. Burn injuries have a large impact on what the person will be able to do when they return; only 47% go back to the same job with the same employer with no workplace accommodations [13].

Burn injuries are one of the most costly health issues to treat [14]. The mean costs of hospital charges per patient in the USA are approximately \$54000 (US dollars) [15]. A previous study from the regional burn centre looked specifically at the cost of medications for hospitalized burn patients; the median cost was \$793 (Canadian dollars) per admitted patient [14]. A reduction in burn injuries would have a significant impact on the burden of the healthcare system.

Measures to reduce work-related burns are different than those intended for residential burns prevention [16]. For example, education should be aimed at chemical handling techniques, and increasing the awareness about hot objects, such as hot oils, metals and steam [16]. In our province, the Workplace and Safety Insurance Board is largely involved in preventing workplace injury [17].

Since 1999, changes in the management of acute burn patients at this regional burn centre have significantly decreased mortality (2.3% vs. 5.6%, $p=0.48$) compared to the previous burn management (1996-1998) [18]. These changes included no hydrotherapy, blood sparing surgical techniques, a restrictive blood transfusion strategy, newer protective modes of mechanical ventilation, aggressive surgical wound excision, temporary wound closure with allograft skin, employment of advanced critical care trained nurses, and increased number of dedicated full-time fellowship trained burn surgeons [18].

The aim of this study is to follow up on two previous studies conducted at the regional burn centre on work-related burns. The first study was a 6 year retrospective report from 1984-1990 [19], and the second a 10 year study from 1999-2000 [3]. The second study compared the incidence and pattern of burn injuries with the initial report and found that there was no change in the past 10 years. We are replicating this study with data from 2001-2010 with a comparison to the previous studies.

This study will help determine if current interventions and education are helping in the prevention of work-related burns, and if more work is needed to reduce the incidence of this preventable injury. We will be able to identify occupations that are currently putting employees at a higher risk of receiving a burn injury, as well identify high risk population groups (gender, age, etc).

Methods

This research study was approved by our institution's Research Ethics Board. This is a retrospective database analysis study. Cases were identified from the regional burn centre database, where patients admitted have been classified as work-related or non-work related. The time period studied was from January 2001 to December 2010.

The main criterion was patients admitted with a work-related burn. Patients admitted for reconstructive cases or with pathology other than burn injuries (i.e., toxic epidermal necrolysis, necrotizing fasciitis) were excluded. Data was collected from the regional burn centre database, including demographics, burn injury characteristics, severity of illness scores (APACHE II [20], FLAMES [21]), and hospital outcomes, with missing information retrieved directly from the patient's hospital chart.

Data was analyzed using SPSS version 19. All values are reported as mean $\pm$ standard deviation. This data was compared to the results of the two previous papers using t-test, analysis of variance, and chi-square test of homogeneity. Statistical significance was set at a p-value <0.05 .

Results

Between January 2001 and December 2010, 1427 patients were admitted to the regional burn centre at a university teaching hospital. Of these, 330 were due to a work-related incident (23%), representing a significant decrease compared with the previous groups (28.2% and 30.2%, $p<0.002$). The mean age of patients was 40.5 ± 11.9 years, a little older than previous groups (38.8 and 32.5 years); ninety five percent were males (similar than previous groups). Sixty-nine percent of the patients came from our immediate urban area, representing a significant increase compared with previous groups (52% and 59.1%, $p=0.0034$). Six patients succumbed to their injury resulting in a mortality rate of 1.8%, which is significantly lower than in previous groups (4% and 6.7%, $p<0.016$) (Table 1).

The mean total body surface area (TBSA) burn was $11.9 \pm 16.2\%$ with a mean full thickness (FT) component of 4.7%. A similar TBSA than the group of 1998-2000 (10.6%), and lower TBSA than the group of 1984-1990 (16.5%); an increase in the mean FT compared with the group of 1998-2000 (1.7%), and a similar FT than the group of 1984-1990 (5%). The anatomical distribution of total body surface burns is illustrated in figure 1. Burns predominantly affected the upper extremities and head and neck.

Inhalation injury was diagnosed by bronchoscopy in 4.8% of patients, representing a significant decrease compared with previous groups (23% and 14.8%, $p<0.00001$).

Mechanical ventilation was required for 68 (20.6%) patients with an average length of use of 16 days. Sixteen percent of patients required escharatomies.

The most common mechanism of burn injury was flame (32.7%) followed by electrical (27%), scald (19.7%), chemical (10.3%), tar (5.2%) and contact (5.1%). Figure 2 depicts a comparison of etiology between the three time periods. Compared with the previous groups, there was a significant increase in flame burns (32.7% vs. 22% vs. 24.4%, $p=0.0367$), and scald burns (19.7% vs. 17% vs. 7.8%, $p=0.001$), but a decrease in tar burns (5.2% vs. 14% vs. 9.3%, $p=0.01$), and contact burns (5.1% vs. 8% vs. 10.4%, $p=0.08$). Patients with flame injuries had the most severe burns. These patients had the greatest length of hospital stay ($22.38, \pm 29.4$ days), largest TBSA ($15.9 \pm 17.7\%$), highest APACHE II score (6.81 ± 7.71) and FLAMES score (-5.26 ± 2.7). The distribution of demographics and severity by etiology is presented in table 2.

The most common work-type associated with burn injuries in the current group were manual laborers (44.5%), followed by electricians (13%) and construction workers (9.7%) (Figure 3). However, the most severe burns were associated with Truck Drivers who had either flame or tar burns related to motor vehicle accidents; this group had the highest Apache II score (7.57 ± 11.443) and FLAMES score (-4.94557 ± 3.682251). These results are consistent with the previous groups.

Discussion

In this 10 year study, 23% of all admissions to the regional burn centre were a result of a workplace injury. Representing a lower incidence compared to both previous papers [3,19], going back to approximately 25 years ago. To reiterate, papers published from the regional burn centre contains a selected subset of the provincial population, and only severe burns are admitted to the centre therefore we cannot generalize the results to the overall population. However, our data has been taken from a similar population set as the two previous papers and therefore can be considered as a valid comparison.

The characteristics of the burn patient were in keeping with previous studies, with a predominant male population in the middle age group [22,23]. The most common and most severe mechanism of burn was due to flame (33%). This result is consistent with recent papers published from other institutions [24,25]. However, comparing to the two previous papers from our centre there is a significant changing trend. We can observe a decline in electrical, contact, and tar burns, and a rise in flame and scald burns. A recent paper published from our research group identified an effective prevention program to reduce electrical burns within the electrician population [26]. We were able to identify a decrease in electrical burns due to the use of multimeters through a multilevel education program and direct mail campaign to update the electrician's equipment. This result may have been captured in our data set and could have contributed to the reduction in electrical burn cases as well as electricians admitted to the burn centre, a decrease from the 23% in the last paper to 13% in our current data set.

Manual laborers represented the largest proportion of admissions to the centre. This is consistent with the previous papers. To our knowledge there have been no recent studies involving a preventative program targeted towards this employment group; this could be because they have a diverse set of skills and different levels of training making it more difficult for a focused program.

There are a few organizations in our province that work on injury prevention in the workforce, such as the Provincial Workplace and Safety Insurance Board, Provincial Health and Safety, and the provincial Ministry of Labor which utilizes principles of the

Occupational Health and Safety Act [27]. For example, Health and Safety Ontario provides courses and resource downloads to help prevent and reduce hazards that may cause burns [28]. Online presence has become popular and an efficient way to spread prevention information. These programs should continue their efforts on work-related burn prevention and focus their attention on flame burns as they have become the most frequent and continue to remain the most harmful.

Conclusion

Our data suggests that there have been significant changes in work-related burn injuries in our province compared to previous papers. The total admission rate has decreased, there has been a change in the predominant etiology, the presence of inhalation injury has declined, and the mortality rate has decreased. Flame burns are now more prevalent which may be a result of preventative programs in the electrical field decreasing their incidence. The management of acute burns has changed at the regional burn centre since 1999 with improved outcomes. We can conclude that prevention programs currently in place may have had a large impact on overall work-related burns, and new measures should be evaluated to target other causes of injuries such as flame burns.

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Figure 1.
Anatomical distribution of burns in current group.

Etiology	Incidence (%)		
	1984-1990	1998-2000	2001-2010
Electrical	37.3	32	27
Flame	24.4	22	32.7
Chemical	5.1	7	10.3
Contact	10.4	8	5.1
Scald	13.5	17	19.7
Tar	9.3	14	5.2

Figure 2.

Etiology of burn injury of the current and previous groups. Tabulated data is presented below the graph.

Figure 3.
Incidence of burn injury by work type.

Table 1

Demographic and severity variables of the current and previous two groups.

Demographic	1984-1990	1998-2000	2001-2010
Age (mean)	32.5	38	40.5
Males (%)	94	90	95.2
Urban Location (%)	59	52	69.1
Mean TBSA (%)	16.5	10.6	11.9
Mortality Rate (%)	6.7	4	1.8

Table 2

Comparing severity variables, expressed as a mean, by etiology.

Etiology	LOS	Days of ventilation	Number of Operations	TBSA (%)	APACHE II score	FLAME score
Chemical	9.12	0.71	0.62	11.928	5.33	-5.72088
Contact	10.47	0	1.06	3.794	1.38	-7.12838
Electrical	16.19	2.45	1.2	9.383	5.65	-5.97445
Flame	22.38	6.52	1.55	15.93	6.81	-5.25586
Scald	10.94	0.35	0.63	10.877	3.14	-6.35509
Tar	22.71	7.29	1.88	11.544	5.47	-5.92153